

# Aviation Week

*Including Space Technology*

15 Cents

A McGraw-Hill Publication

November 3, 1958

**Navy Unveils  
Low Cost  
Sounding Rocket**

Doak Model 16 VTOL



## Meteor-Burst Avionics Resists Jamming



## ORDNANCE CAPABILITY

Today, the Ordnance Group at Rheem's Defense and Technical Products Division is hard at work on missile warhead systems, fire systems, ballistics and lethality studies, explosive research, and mines and mining technologies. Current work for Rocket and Propulsion Airfields, Army Ordnance, and the Navy Bureau of Ordnance includes research, development, production, testing and testing of missile warheads. To supplement ordnance engineering and production facilities at the Division's main plant at Downey, California, a separate Ordnance Landing Facility was built by Rheem in 1958.

Current work projects and expansion programs ensure that the Rheem Manufacturing Company will continue to maintain the leadership in ordnance research, development, and production that it has held for the past sixteen years. During World War II and the Korean Campaigns, millions of shell cases, projectiles, anti-tank and anti-personnel mines, and depth-charges were poured forth from Rheem plants to our fighting front lines. New Rheem-developed manufacturing processes like the "hot-rolled draw" significantly increased production volume and decreased costs. For full particulars on Rheem **ORDNANCE CAPABILITY**, write for Data File AP-107-1.



Typical example of Rheem's depth in ordnance: Rheem-developed Super Nuke nuclear system being tested on nuclear sled also built by Rheem.

**RHEEM MANUFACTURING COMPANY**  
Defense and Technical Products Division  
12311 Woodloch Avenue, Downey, California



## When liquid feeding is critical...



The flow of fluids, precisely controlled and metered, means life or death—in an intensive system, too. LGS, Argo, JP-4, alcohol, water—no what-ifs here—you—the right amount must reach the right spot at the right moment. To do this may require a valve, a pump, a regulator, a hydraulic or electrical meter—or a complex system measuring any or all of these components. Whatever the answer, it must be reliable.

At Hydro-Aire the liquid feeding of airborne systems has been fixed for thought for more than 35 years. Much a complex fluid control problem has been well disposed by our outstanding test and development laboratories. Right now thousands of Hydro-Aire products are handling tons of operational fuel. How about feeding us your requirements?

**HYDRO-AIRE**

HYDRO-AIRE CORPORATION  
A Division of RHEEM  
12311 Woodloch Avenue, Downey, California  
Telephone: (213) 291-1111  
Telex: 251-1111



# SARGENT

## SERVO-SYSTEMS OF FORCE CONTROL



With 38 years acceptance Sargent builds precision linear and rotary hydraulic, pneumatic, mechanical and electronic systems of force control to meet successfully the increasingly high requirements of marine, aircraft, missile, petroleum and industrial use. From original idea to finished product - SARGENT.

## SARGENT FACILITIES

Research  
Design  
Development  
Testing  
Qualifying

### Manufacturing

including –  
Machining & Grinding  
Heat Treating, all types  
Plating, all types  
Inspection  
Assembly

## SARGENT BUILDS

Servo-Systems	Pneumatic Cylinders
Hydraulic Systems	Pneumatic Valves
Integrated Packages	Ball Screw Actuators
Hydraulic Actuators	Gear Actuators
Hydraulic Valves	Gear Accessory Boxes
	Electronic Systems

*Standard of Excellence*

Since 1920

## ENGINEERING CORPORATION

JAMES CROCE &amp; FLAHERTY, 3809 E. FIFTY-SEVENTH ST.

HUNTINGTON PARK, CALIF.

— U.S. Supreme Court

## AVIATION CALENDAR

Nov 9-13: 1976 Annual Convention and Lecture Series, National Oceanic Time Symposium Area, Boulder (Invited) David S. Lewis, Pres.

Nov 10-12: 1976 Fall Vertebrate Division Dinosaur Advertising Club, New York, N.Y. Principal speaker: Dr. George S. Schindler, D. C.

Nov 12-13: 1976 Vertebrate Conference, Paleontology and the Atmosphere and Space Symposium, the School of Art and Medicine, San Antonio, Texas

Nov 13-14: 1976 Vertebrate Conference, Santa Monica, California. President: Dr. S. S. Sumner. Flight Safety Foundation in cooperation with Aeronautics Administration Board's National Aviation Facilities

Nov 15-16: 1976 Annual Convention, Montreal Electrical Manufacturers Union, Hotel Thompson, Montreal, Que. N.Y.

Nov 16-17: 1976 Fall Convention, London, England. The American University, Washington, D. C.

Nov 17-18: 1976 Annual Convention, New York, New York. Plenary Session, New York, New York

Nov 18-19: 1976 (Special) Vertebrate Conference sponsored by Volcanic Institute, Montreal, Quebec, Canada

Nov 19-20: 1976 Vertebrate Society for Experimental Stress Analysis, Sheraton Hotel, Albany, N. Y.

Nov 19-21: 1976 Conference on Scientific Basis of Human Factors, Washington, D. C. Co-sponsored by USARF Office of Scientific Research, National Academy of Sciences, National Science Foundation

Nov 17-18: 1976 Annual Meeting and Society Dinner Conference, American Society for Dental Control, Baltimore (Hotel)

Nov 17-18: 1976 Annual Meeting and Society Dinner Conference, American Society for Dental Control, Baltimore (Hotel)

(Continued on page 6)







## MORILITY



**NO JOB'S TOO TOUGH—WE DELIVER ON SCHEDULE**

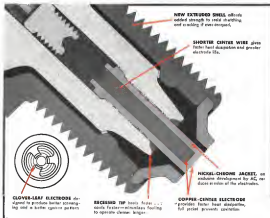
Woods equipped takes in the air in the Paving yard, E-12, breezeway which New 500 built. Near ground support equipment from Wind Canal in last side of Cape Canaveral, Florida. And last, beyond takes 55' breezer-enclosed section, launching base on aircraft which latter lateral was then in a solid stream.



FOOD MACHINERY AND CHEMICAL CORPORATION  
Ordnance Division

4405 COLLEMAN AVENUE SAN JOSE, CALIF.

## HERE'S BIG NEWS ABOUT THE "BUSINESS END" OF A SPARK PLUG



NEW AC-273-D AIRCRAFT SPARK PLUG FOR THE "HOT SPOT" IN P&W 2800 ENGINES



## AIRCRAFT SPARK PLUGS

Other types of AC Aircraft Spark Plugs, of equal quality, are available for all applications in both commercial and private planes. Contact your AC Supplier for the proper plug for your particular application!

© 2004 West Group. All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or by any information storage and retrieval system, without prior written permission from West Group.

AC 10988 FIG 2 The distribution of values of  $\alpha$  and  $\beta$

[illegible]



# Vibration and Shock ENGINEERING REPORT

A Case History of Environmental Control...No. 3

## PROBLEM

**TO PROTECT VERTICAL GYROSCOPE** in jetfighter radar fire-control systems from shock and vibration of combat maneuvers, gunfire recoil, and rough landings.

## SOLUTION

**ENGINEERED MOUNTING SYSTEM** MODEL 1900 safeguards vital aircraft performance and equipment reliability.

Robinson MET-L-FLEX resilient cushions of specially fabricated stainless steel wire provide a greater damping factor—actually 5 times that of rubber. Loading performance at the structural mounting system is assured regardless of exposure to oil, dirt, moisture, acids, and temperature extremes.

### SPECIAL FEATURES

Angled resilient elements add to equipment stability, reduce space requirements, and contribute to excellent rotational stability characteristics.

### PERFORMANCE

With a vibratory test acceleration of 10 G, Model 1900 provides 242 vibration strikes in the 200-500 c.p.s. frequency range allowing only .01 G to reach the equipment. Vertical and horizontal natural frequency is 13.7 and 9.2 c.p.s. respectively. Due to high damping, peak acceleration force to which equipment is subjected is limited to 1.4-1.6 G at mounting system resonance.

Rotational displacement of gyro, a critical factor affecting performance, is restricted to a fraction of a degree even during resonant conditions.

### RESULTS

More dependable operation of the radar fire control system, hence greater operational reliability of the aircraft through application of a Robinson shock and vibration control mounting system.

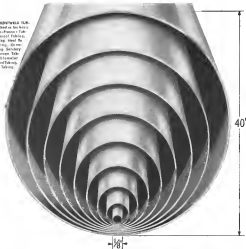


MODEL 1900  
MOUNTING SYSTEM

By applying Robinson's concept of controlled movement in the design of MET-L-FLEX suspension systems, more than thirty-seven different gyro mountings have been successfully developed and produced in quantity.

ROBINSON CONTROL IS RELIABILITY CONTROL  
**ROBINSON AVIATION INC.**  
TETERBORO • NEW JERSEY  
West Coast Engineering Office: Santa Monica, Calif.

CONTINUOUS IMPROVED TUBING is available in the following applications: Pressure Tubing, Mechanical Tubing, Aircraft Tubing, Heat Exchanger Tubing, Steam Tubing, Chemical Tubing, Seismic Tubing, Research Tubing, Large Diameter Tubing, Special Tubing, and Process Tubing.



TRENTWELD tubing is equal in strength and has more uniformity than tubing made by any other method of manufacture

Trent offers tubing in sizes ranging from 1/8" to 60" O.D. and in a wide range of grades. These include Bestelloy<sup>®</sup>, Inconel<sup>®</sup>, Incolloy<sup>®</sup>, Titanium and 15-5-20, grades. All are made by an exclusive welding process—Contour Trentweld<sup>®</sup>—which virtually eliminates the heat treatments, by cold working and annealing after welding. Trent makes the weld equal in strength and corrosion resistance to the parent metal.

To insure that Trentweld tubing

is of the highest quality attainable, a rigorous quality control program is carried out. Samples of each lot are tested under Periodic tests—Battling, reverse bend, flare and flange, crit. and pressure—are conducted. Rigid corrosion tests are made on all lots intended for corrosive applications. When requested, a unique "angle-wall" X-ray inspection is made on your first shipment of a new, uniform product.

Why not take advantage of Trent

quality when you order stainless or high alloy tubing? For further information, write for the Trent tubing handbook, Trent Tube Company, Kent Troy, Wisconsin.

Continued on page 10, left to right

**CONTOUR  
TRENTWELD**

**TRENT  
TUBE  
COMPANY**

Subsidiary of Smith Bar Company of Atlantic General Offices: EAST TOWN WASHINGTON FIELD EAST TOWN WISCONSIN 53090





SAYS JOHN G. GLENN, Superintendent of Communications and Electronics, Bonanza Air Lines, Inc.

## "G-E 5-Star Tubes Like This Help Us Link 21 Cities with Fast Air Service!"

"Communications—our navigation—both are vital to Bonanza in maintaining on-time schedules in the west and southwest.

"Many of our flights, such as Salt Lake City to Phoenix, and Las Vegas to Reno, cross the most active traffic flow—we are made over sparsely settled mountain areas. Our pilots must have height, cover, weather, and other vital information in their fingertips.

"These General Electric 5-Star Tubes give us the extra dependability we require of our radio and navigation instruments. We use 5-Star Tubes in all critical sections, both in our airborne equipment, and in the

network of transmitters and receivers Bonanza utilizes in every one airport.

"With still faster flight schedules coming, made possible by our new F-27 Silver Dart turbo-prop planes, General Electric 5-Star Tube reliability will mean still more to us. Bonanza's faith in these specially-built tubes comes from many years' experience. They are a superior product, and give superior service."

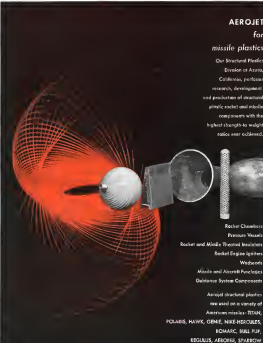
Your nearby G-E distributor stocks 5-Star high-reliability tubes. Phone him! Distributor Sales, Electronic Components Division, General Electric Company, Greenville, Kentucky.

*Progress Is Our Most Important Product*

**GENERAL  ELECTRIC**

**AEROJET**  
for  
missile plastics

Our Structural Plastics  
Division in Azusa,  
California, performs  
research, development,  
and production of structural  
plastic rocket and missile  
components with the  
highest strength-to-weight  
ratios ever achieved.



Rocket Chambers  
Pneumatic Valves  
Rocket and Missile Thermal Insulation  
Rocket Engine Igniters  
Webbells  
Missile and Aircraft Pyrotechnics  
Guidance System Components

Aerojet structural plastics  
are used on a variety of  
American missiles: TITAN,  
POLARIS, HAWK, GEM, NIKK-HERCULES,  
BOACAC, BALL FUP,  
REGULUS, ARROW, SPARROW



A SUBSIDIARY OF THE GENERAL TIRE & RUBBER COMPANY

Expansive facilities—inspire outstanding opportunities in Azusa. (Plants at Azusa and near Sacramento, Calif.)



## Raytheon Missile Projects

**RAYTHEON**



**SPARROW II**—the Navy's medium altitude anti-aircraft missile is intended for extensive use by Navy ships to clear air defense. Sparrow II is a Raytheon prime contract.



**HAWE**—the Army's defense against low-altitude attacks—comes out in destruction in the third line of microwave radar. Hawk development and production is under Raytheon prime contract.



**TARUS**—A subsonic cruise for anti-aircraft missiles in the Navy's defense against low-altitude attacks is sold by Raytheon. This employment is working well and extended until—until it is too late—along to keep a path through missile launch.



**ADVANCED PROJECTS** in electronic systems as well as missile guidance and control are now underway in Raytheon laboratories. These facilities are currently being added for this work.



**PRELIMINARY NEW DESIGN** of tomorrow's missiles will result from the advanced work being done for today's missile systems. Raytheon plays an important role in this work.

Raytheon diversification offers

## JOB STABILITY FOR CREATIVE MISSILEMEN

Here is an opportunity to free yourself of worry about a job that's here today, gone tomorrow.

**Diversified assignments**—only possible in a company with Raytheon's wide range of missile contracts—means security not found in one- or two-project companies. You apply your creative energies to the many projects you work on, and they in turn are your "insurance" against falling into a rut.

**Individual recognition** comes quickly from Raytheon's young, engineer assignments—men who are fairly aware of the engineer's needs and contributions to missile progress.

**Dynamic Raytheon growth**—the fruit of this management's progressive policies—is best illustrated by the fact that Raytheon is already the only electronics company with two prime missile contracts—Navy Sparrow III and Army Hawk.

The next step is up to you. Why not get frank answers and helpful information on the type of job suited to your background and talents, its location, salary and other pertinent details. Write, visit or telephone collect. The number is (Roslindale 4-7300 in Bedford, Massachusetts. Please ask for J. Cline Egan.

**RAYTHEON OPPORTUNITIES NOW OPEN IN:**  
WEAPONS SYSTEM ANALYSIS • CONTROL SYSTEMS  
• PACKAGING • MICROWAVE • RADAR • SPECIFICATIONS • MISSILE AERODYNAMICS • WIND TUNNEL TESTING • AERODYNAMIC HEATING • SOCKET ENGINEERING • VIBRATION MEASUREMENT AND DATA REDUCTION

**RAYTHEON MANUFACTURING COMPANY**  
Missile Systems Division, Bedford, Mass.



MISSILE SYSTEMS  
DIVISION

Bedford is Electronic



## all in the day of a RAVEN

*Flexibly—sticking critical battlefield equipment anywhere, anytime—is only one of many vital duties for the Army H-30D RAVEN. Its brand of multi-mission versatility is essential to Army Aviation's role in a modern age that has forgotten the meaning of station-quo.*

*Good natured and rugged, the H-30D can be depended upon for every light helicopter requirement: observation, command, rescue, insertion, combat rescue, medical, communications, liaison, news flying, and photography. To mention a few. Performance is the key. Performance, high load and space capacity built into a rugged ship.*

*And now, Hiller has added a 305 hp engine in the same basic ship. The result is the 322, a three-place helicopter with great capabilities.*

**HILLER**  **AIRCRAFT CORPORATION**  
PALMDALE, CALIFORNIA • WASHINGTON, D.C.





# 4½ hours coast-to-coast on American's Jet Flagships!

The first jet service in the U.S.A. starts in January



**American invites you to  
enjoy a new and  
wonderful experience**

In January, American Airlines inaugurates the first jet service coast-to-coast in both directions between New York and Los Angeles. Soon after, Americans will extend its jet service to Chicago, San Francisco, Dallas, Washington, Baltimore, Boston and other major cities.

**Now for the first time,  
getting there becomes a real pleasure**

Because the introduction of American's Jet Flagships will not existing flying times by as much as forty percent, you will reap the benefits of extra useful time for both business and pleasure.

But speed is not the only remarkable advantage of jet flight. The 707 Jet Flagship cruises at serene altitudes well above turbulence, giving you the smoothest flight of your life. And inside the plane itself, the quiet adds to your relaxation. For engine noise and vibration, the two factors that contribute most to travel fatigue, have all but vanished. Minutes after you've airborne, you'll discover that jet flight is completely restful.

Your first step inside American's Jet Flagship is all it takes to see what luxury is in store for you. The cabin is longer, wider, more elegant than any plane you've ever been in. The seating seats are deeper, softer and there's more space between them. Comfortable air-conditioning works on the ground as well as in the air. There are a host of other innovations for your comfort and pleasure.

Be one of the first to take advantage of the countless opportunities of jet travel, the sheer delight of jet flight. Starting in January, let Americans prove to you that getting there has become a real pleasure.

**The Boeing 707 Jet Flagship is the most  
tested airplane ever to enter service**

The prototype of the 707 made its initial flight in July, 1954. It has been flown continuously ever since undergoing four years of the most thorough testing ever given any commercial airliner.

**AMERICAN  
AIRLINES**

*First with Jets in the U.S.A.*









• Use for any exposed control or indicating application on aircraft or machines.

• Corrosion resistant — Stainless Steel or Alclad used for all exposed metal parts.

• Heliarc welded for positive sealing and added strength.

• Meets all requirements of Intervention Test M1-6-3372, Procedure I.

• Header is brazed (not welded).

• Mount anywhere — through any mounting hole. Infinitely adjustable within  $\frac{1}{8}$ " — wire bending.

• Multi-Circuit Control: 6 separate terminals permit many circuit combinations.

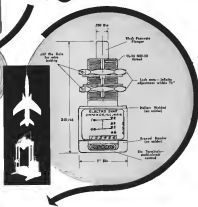
• High-temperature and universal base provides positive for lasting characteristics to ensure perfect, dependable operation.

• Light and Compact — yet rugged and impervious to all environment conditions.

**NOW...sealed dependability in an adjustable, rugged, environment-free**



**LIMIT SWITCH**



**opening characteristics**

Control Arrangement	2-5725
Pressure	250 lbs.
Resistance Differential	250 lbs.
Overload	330 lbs.
Operating Force	200 lbs.
Stroke	2.00 in.
Distance of Operating & Rest	0.05 in.
Between Set-Back	30 in.
Operating Force	30 lbs.
Overload Force	40 lbs.
Release Force	4 lbs.
Electrical Rating	250 VAC, 40 Hz
See Text for 500 VAC	250 VAC, 40 Hz
Rated Temperature Range	-100° to +250° F
Weight	25 lbs. Approx.



**ELECTROSNAP CORPORATION**

1111 West Lake Street, NEW BRUNSWICK, N.J. 07003  
Chicago 34, Illinois NEW YORK 100, New York

For full details, write for Data Sheet DS-4. Ask for information on the many other Electro-Snap sealed switches.

**NORRIS DESIGN IN A COMPLETE LINE OF SWITCHES**



# EDITORIAL

## Reflex in Spain

Not long ago we spent more time on the air, scrubbed Castilian plains near Madrid where the 16th Air Force of Strategic Air Command is now in the magnet factory business. Then, at Torrejon, stretches the largest paved runway in Europe—17,580 ft. of concrete flanked by an enormous concrete parking area a mile and a half long and a quarter mile wide. On this parking apron surrounded by long coils of barbed wire stands a perpetual vigil of a half dozen or more Boeing B-47s loaded with magnet weapons, full tanks of JP4 fuel, clusters of JATO bottles changed to their silver flasks and cross struts dressed in living gear never more than two minutes from the flight line.

This is what SAC's "Operation Reflex" looks like as it is poised on a highly cooled system than can fire these magnet-laden bombers off the runway toward Soviet targets within 15 min. from the sound of the alert klaxon. Operation Reflex is the carefully-forged, insurance-tempered spearhead of Strategic Air Command's retaliatory capacity and the backbone foundation on which United States military power and foreign policy rest today and for the immediate future. The sight was one of Torrejon is also repeated at other SAC bases in Spain—Zaragoza in the north and Merin in the south near Seville. The SAC bases in French Morocco and England are also dotted with Reflex bombs on poised on the 15 min. hair trigger.

The B-47s of Reflex are rotated from state-side SAC bases to the perimeter of advanced bases such as Torrejon only a few hours flying time from the Soviet Union. Aircraft and crews are rotated through the Reflex complex in single units so as never to impair the mass operational efficiency of those combat wing at its home base. While they are on their work of Reflex duty the two of B-47 crewmen never leave each other's sight. They work and play together within the limits of their alert confinement, always with a mid-painted Reflex jeep within a few strides. This too is their flight gear.

Even when manning at the base pools, they must have their flight gear draped over the jeep at the pool side and, when the alert klaxon sounds, they dive into their flight clothing and drive toward the flight line with a foundation of wet tracks. All of the roads as the Torrejon base are paved with an orange stripe leading Reflex crews by the shortest route to the flight line and their parked bombers. When the alert klaxon sounds, red lights blink on all the base road intersections. Normal traffic pulls over to the roadside, leaving a clear path for the hurrying jeeps of the B-47 crews.

Within two minutes of the klaxon blast, the crews are

scheduled to let the flight line perimeter. Within four minutes, they must be at their flight line check point and, within eight minutes, they are embarked in their bombers ready to start engines. Maintenance crews for Reflex give the aircraft a constant check to keep them in instant readiness. Flight crews are briefed once every 24 hr. on their specific target in the Soviet Union.

At the end of 14 min., engines have been started, the aircraft taxied to the end of the runway and, at 15 min., the first B-47 is rolling toward takeoff. There are three kinds of practice alerts for Reflex crews, and there may be several called during each 24 hr. period.

In an Alpha alert, the crews must move their aircraft. For Bravo, they start engines and begin taxing. For Charlie, they taxi to the end of the runway, pull engines to full power and start rolling before changing throttles and returning to their parking stand.

No one knows whether it is a practice alert or the real thing until the role word is flashed to them at each stage of the alert. When they open throttles at the runway's end, they don't know until they get the power signal whether they are taking off into the third World War or returning to the flight line.

Reflex was developed under Gen. Thomas S. Power, SAC command, to prevent the spread of its technology striking force from being caught on the ground by an arm of Soviet weapons, including ballistic missiles. The Reflex detachments are properly kept sufficiently small to be able to get off any night runway within the 15 min. span. Their bases are widely dispersed to require a major effort to annihilate them.

There is little doubt but that a run of Soviet ICBMs were operational in Russia and being replaced in Soviet satellites further to the west such as Poland, Albania, and Romania, could eventually knock out the advanced SAC bases in Europe and North Africa. But with Reflex, they would find it virtually impossible to do this task, before the B-47s were in the air with magnet loads destined for Soviet targets.

SAC makes no secret of its Reflex capability, which is growing with its disposal program. If he feels the Soviets should know in detail and postulate the retaliation they face for any future aggression. When crises such as Lebanon and Qaddafi develop and the world spins again toward the brink of major war, the power of Reflex is reinforced. The shadow of its B-47 and B-52 wings grows larger over those who might engineer aggression. This is what Strategic Air Command means in its dynamic deterrent. This is what is keeping the world away from major war today.

—Robert Hays





## PRESSURIZING AVIONIC SYSTEMS

Eastern pressurization equipment protects vital electronic gear. A continual program of research and development creates customized pressurization units that keep the performance of avionic systems unaffected by altitude and ambient conditions. Custom units that meet military specifications help to solve your problems when recommending electronic components.

When you have a challenging problem to prevent pressure, or heat, or moisture, or dust from affecting electronic performance, come to Eastern for complete and creative engineering help.



100 SERIES  
PRESSURIZATION UNIT



100 SERIES  
PRESSURIZATION UNIT

### EASTERN PRESSURIZATION UNITS

A variety of capacities accommodates a broad range of requirements and meets appropriate government standards. Typical units operate from sea level to over 70,000 feet at temperatures from  $-65^{\circ}\text{F}$  to  $+160^{\circ}\text{F}$ . Delivery: 0-3500 cu. in./min. free delivery. Discharge Pressure: 0.40 p.s.i. Standard sub-assemblies and components normally are used to create a custom-made design to fit your exact needs. Units may consist of an air pump and motor assembly, pressure switch, check valve, tank valve, terminal connections, and dehydrator.

Write for Eastern AVIONICS BULLETIN 340



# Eastern

**INDUSTRIES, INC.**  
100 Skiff St., Hamden 14, Conn.  
West Coast Office: 1698 Coastline Avenue  
Beverly Hills, California — Phone ORegon 8-2958

## WHO'S WHERE

### In the Front Office

**Ken Allen, James A. Thomas** (USN, ret.), vice president, Kaman Aircraft Corp., Bloomfield, Conn. Also Robert A. Straub, director of maintenance, Kaman Helicopter Division, Bloomfield, N.H.

**Roger T. Carver**, vice manager, Hughes Aircraft Systems Division, United Aircraft Corp., Los Angeles, Calif. Also Charles F. Miller, assistant manager of Mission and Space Systems.

**Blair Witell, Jr.**, a director, the Garrett Corp., Los Angeles, Calif. Mr. Witell is vice president and manager of Garrett's Aerospace Manufacturing Division.

**Mag. Gen. Frank G. Glavin** (USAF, ret.), a former Starke, Aviation Corp., Detroit, Mich.

**Mr. Gen. Hugh J. Koen** (USAF, ret.), head of the Lockheed Aerospace Systems Division, Burbank, Calif. Mr. Koen is vice president and general manager of Pratt & Whitney Division, Burbank, Calif.

**Richard C. Gossard**, president and treasurer, Cal Trans Corp., a division of Aero Systems Products, Inc., Los Angeles, Calif. Also **Robert J. Cabot**, general manager and **Arthur J. Jensen**, secretary and general counsel.

### Bonuses and Elections

**Walter H. Johnson, Jr.**, Capital Aircraft Corp. president, has been elected board chairman of all three New York Aeronautics Corporations.

**Arno H. Hammer** of Kellogg-Durham, N.C., has been elected president of the Southwestern Aircraft Museum's **Ann Frank J. Selzer** of West Palm Beach, Fla., was elected vice president and **Mark V. Fisher** of Bennett Bendone, Fla., elected secretary-treasurer.

**Dr. Charles S. Draper**, head of the Aero-Astronautics Engineering Department at the Massachusetts Institute of Technology has been awarded the **John William II. P. Reynolds Gold Medal** by the American Society of Aeronautics for his contributions to the progress of aeronautical engineering and the development of advanced signaling devices.

### Changes

**Edith E. Lanning**, chief, Ground Safety Division, Office of Flight Operations and Aeronautics, Civil Aeronautics Administration, Washington, D.C.

**Robert Adams** recently transferred to A-1 Systems (USN, ret.) as manager of operations, Washington, D.C. **Richard Bell** (USN, ret.) is manager of operations, Los Angeles, Calif. **Conradine**, Springfield, Mass., is vice president. He has been granted a leave of absence to act as advisor to the director.

**John H. Dwyer**, Director, Mission and Defense Systems Administration, U.S. Department of Commerce.

**Gerold C. Selzer** has joined the general manager's office of the Hughes Aircraft Co., Torrance, Calif. **John Selzer**, Mark

(Continued on page 87)

## INDUSTRY OBSERVER

►Soest Bomber delta wing bomber (AWC Det. 27, p. 21) has a wingspan estimated at about 75 ft and a fuselage length close to 200 ft. Its major engines are located on thick leading edge of the delta wing close to the fuselage. Bomber has a bow-like nose with the main landing gear folding into the fuselage and outrigger wheels folding into the wing from the wing root. Auxiliary powerplants of an underslung type also are located in pilot mounted pods swept forward from the wing on both sides of the fuselage.

►Accidental detonation of a destruct package in first stage caused ignition and burning of second stage of Navy's Polaris fleet ballistic missile test p. 63) in annual test at Cape Canaveral, Fla. (AWC Det. 28, p. 24). After failure of a Polaris test vehicle at Canaveral has been attributed to failure of the missile command guidance programmer once the missile lifted off the pad properly but failed to follow its planned trajectory.

►Royal Canadian Air Force is looking for a new type fighter to replace the Canadian-built wingless wingless jet with NATO. New plane will switch Canadian NATO mission from air defense to low level attack. Performance planning indicates a two-sensor advanced aircraft capable of delivering nuclear and conventional weapons over a range of less than 1,000 mi.

►Special planning team for satellite interception and destruction conceived by Radio Corp. of America reportedly have secured a possible satellite intercept in Advanced Research Projects Agency. RCA is one of two companies working on satellite interception problem under Air Force contract.

►Pilotless version of Lockheed F-104 in a missile interim is under study by the Defense Department. Lockheed has proposed autonomous satellite kill and air-to-air missile systems based on the F-104 airframe.

►Number of jets, including General Electric, Lycoming, Hughes and Fintone, are bidding for the contract to supply ground power units for North American's B-70 bomber. Support units, known as short pods, would be required to supply continuous power as well as extra power for starting engines, probably be built around a shaft turbine engine in the 1,000 hp category.

►Chance Vought is making a quiet bid to move into the Army missile program, with its top management controlling 51 million in contracts. Such a move would require a major reorganization of the company's missile division. The company is scheduled for firing on a limited stage at Redstone Arsenal in January. Chance Vought approach in development of a family of basic missiles whose capabilities can be varied by matching any of several different quick-throw rocket propellers. Missiles to be test fired at Redstone Arsenal in North American's Redstone missile as a qualifying event for the controlling flight tests.

►Ryan Vertigo vertical takeoff VTOL and Hawk Model 16 ducted fan aircraft have begun their test programs. Vertigo has been flight tested and is undergoing a series of tests in National Aeronautics and Space Administration's Ames Laboratory wind tunnel. Hawk Model 16 (jet engine) has been undergoing two main, brief tests of the ground at the start of its 90-hour ground test program. Vertigo 75 tilt-wing VTOL/STOL has made some 15 successful flights, but its flight program contract extended to cover 10 hr. for stability investigations.

►Rohm Manufacturing Co.'s SD-3 combat surveillance drone and Republic Aviation Corp.'s SD-3 missile are now in competitive Army Signal Corps trials at White Sands, N.M.

►Douglas Corp. cost studies on shipping military material in its large C-119A military freighter in comparison with surface transport (AWC Det. 28, p. 24) show per unit cost can be saved by utilizing a Bell H-13 helicopter transportation to Japan, \$7,700-45 per C-119A delivery and \$7,157-57 per Sikorsky H-13 shipment.





## ..... CHANNELING THE AIRWAVES.....

### A project of Colonel Edward A. Allen (USA Ret.) Senior Staff Engineer, Stavid Engineering, Inc.

In 37 years of military service, Colonel Allen has contributed greatly to the evolution and development of all types of communications equipment for the Army Signal Corps. Currently assigned to Project Monmouth III, Colonel Allen serves as a liaison to resolve communications and spectrum interference problems associated with the modern dispersed field army. Like other outstanding scientists and engineers at Stavid, Colonel Allen is working on advanced concepts... years ahead of actual systems development.

In Stavid's objective engineering atmosphere, scientific development and manufacturing teams are producing a wide range of electronic systems for the Services. A current project, for example, will be for the development and testing of the Mark 70 Gun Fire Control System.

**STAVID Engineering, Inc.** Fairfield, New Jersey  
*Imaginative Electronics...*

#### OTHER STAVID PROJECTS INVOLVE:

- LARGE Weapon System
- Infrared Search and Track Equipment
- Search and Fire Control Radar Systems
- Missile Guidance Systems
- Automatic Assembly of Electronic Equipment
- Airborne Search/Tracking and Terrain Classification Radar

Engineers and Scientists Join Stavid's Advanced Systems Engineering Team.

## Washington Roundup

### Nuclear Plane Competition

Plans in Defense Department of Navy and Air Force aircraft nuclear propulsion programs to intensify their competition between the two services may mean still more delay as a field already plagued by delays. Some sources say the problem is that the two programs are technically compatible but not politically so. If the services get together and supported each other's efforts, there might gain enough financial and administrative support to ensure technological advances for both. Instead, they are drawing further apart in the competition for funds, and most eyes are the prospect for both, observers say.

### 'Defense in Depth'

Both Army's Nike Hercules anti-aircraft missile and Air Force's longer range Boeing interceptor missile definitely will be used as a part of the "defense in depth" concept, although details as to numbers and location of sites still are under study, according to Acting Defense Secretary Donald A. Quarles.

Congress, changing disposition of defense programs, cut 20% from the defense construction fund for each weapon and directed Defense to decide on the division of funds. As a result both systems were re-evaluated and some plans are expected that now might be eliminated.

Tales, meanwhile, will still show, but hard as it is undergoing launch studies, but there is no plan now to deploy it on land, Quarles said. Developed for Navy, the Titan concept anti-aircraft missile was at one time planned for Air Force use to protect Strategic Air Command bases. A redefinition of roles and command two years ago gave it to Army for continental defense, and it has been undergoing studies ever since.

### World Congress of Flight

Air Force Ann's April World Congress of Flight, scheduled for April 12-15 at Las Vegas, Nev., and sponsored by four other organizations, will bring together conference on civil jet aircraft models and the space age. It also will include a large industrial exhibition, military, flying and live power demonstrations and meetings of aviation and space organizations.

Aviation symposiums, sponsored for the past two years by the Air Force Office of Scientific Research and planned for Washington, D. C., area April, has been added. Last national agency of a will be incorporated into the Congress' Space Age Conference. Question of whether new technical aspects can be squeezed into the aviation program still is pending. Co-sponsors for the Congress include Air Transport Association, National Aeronautics Association, Flight Safety Foundation and the Space Education Foundation. The 3-day meet occupies AF's annual Air Fair Grounds.

### Week of Change

Other top-level shifts also were in the making in Washington last week. They included:

• Dr. Paul D. Foele retired as Assistant Secretary of Defense for Research and Engineering after a year in the post. Foele's office probably will be shifted to Las Vegas, and the Administration looks a shiftable and willing candidate to fill the new post of Director of Research and Engineering. The new office, slated to have much broader power than Foele's shop, was authorized under the year by Congress under the Defense Reorganization

Law. Foele, 70, had spent a total of 15 years in government service. His early career was spent with the National Bureau of Standards. He later was vice president of Gulf Oil Corp.

• Lt. Gen. Donald E. Pett, retired Air Force deputy chief of staff for development, was named to replace Dr. James H. Doolittle as chairman of USAF's Scientific Advisory Board. Doolittle is retiring from the chairman's post because of his heavy workload as a member of an other government committee and work in private industry but will continue to serve as a member of the advisory board. Pett is now president of United Research Corp., a recently formed subsidiary of United Aircraft Corp. (AW Oct. 26, p. 17).

• Milton W. Arnold resigned as senior president, aeronautics-engineering of the Air Transport Association. However, reports that Arnold will join the Federal Aviation Agency, as an other government agency, as an executive capacity. Instead, look for Arnold to become president of an aviation firm, probably outside the transport field.

### Subsidy Proposal

Members of the Arms of Land and Terrestrial Aeronautics meeting in Honolulu on Thursday and Friday of this week, will begin a study of a new proposed plan to streamline methods for determination of subsidy to be paid local-service firms. The plan also proposed by the Civil Aeronautics Board staff and submitted to the cabinet for review, is to pay each carrier on a monthly basis a predetermined portion of a standard cost of operation per plane mile for a given number of hours per year each airline agrees.

### NASA-ABMA Progress

Despite official indications to the contrary, led by NASA to take over a major share of the space services now held by Army Ballistic Missile Agency and Army's Jet Propulsion Laboratory which is managed by California Institute of Technology after several years, will adjust the next meeting of the National Aeronautics and Space Administration Council scheduled for late this month.

### New USAF Scientist

To replace Dr. Joseph W. Charney, general manager of the Space Technology Division of Aeronautical Systems Inc., a Ford Motor Co. subsidiary, to step up as chief scientist of the Air Force, Charney, who will take over his last post assigned June 1, succeeds Dr. George Villard, Villard already has completed his term as chief scientist and has been at the Air Force of Arlington, Va., as director of development planning.

### Strike Tension Grows

Tension continued to mount in airline labor disputes last week with the spotlight still on the Capital Airlines International Association of Machinists strike which is regarded as a possible case law for IAM negotiations with five other major carriers.

As the Capital strike pushed past the two-week mark, other union negotiators declared a cooperator offer as much above the 20-hour week figure recommended by an earlier presidential emergency board meeting (AW Oct. 27, p. 14). Trans World Airlines announced plans to lay off 19,000 employees as a result of an Oct. 31 strike date by the local IAM negotiators.

—Washington staff



# Confusion Clouds German Fighter Choice

European reports that German Defense Ministry has chosen F-104 either premature or inaccurate.

By David A. Anderson

West-European reports that the West German Defense Ministry has chosen the Lockheed F-104 Starfighter as either premature or inaccurate. Aviation Week has learned here.

The only firm German decision to come out of the numerous hanglows in the Rhein valley is two-fold: •Both the German F104-IT Super Tiger and the F-104 fighter are still in the running for the prospective order, with the Starfighter officially rated to be leading in a head-to-head. Major factors in the final choice will be the terms proposed by Lockheed for license production of the Starfighter in Germany. U.S. sources regarded German emphasis in the decisive importance of the licensing agreement as an effort to win still further price reductions from east or both contractors. Both Lockheed and Germanies are expected down to the rack bottom line.

•Dassault's Mirage 1A has been eliminated as "not meeting material and technical requirements at this time." •The choice in the arms race of the end of last week. It is confirmed that the statement of the German Defense Ministry. It is further supported by unofficial news of industry and military representatives of the United States clearly to the West.

German Defense Ministry spokesmen denied last week that a decision had been made. He refused comment on the implications of a Ministry statement that the Starfighter was favored slightly over the Super Tiger. He was

asked if the Defense Ministry would reconsider purchase of Starfighters if Lockheed agreed to favorable license conditions and again refused to comment.

"If the Germans have not said anything, we don't know about it," said a Lockheed USAF official.

Neither the Federal and sales representatives of General Electric, aircraft factories of the F-104 engine which will be used in either airplane. German and Lockheed sources said there has no official word on a final decision.

To add further evidence, the decision for the fifth German team visit to the United States still includes Germanies as one of an essential member. Steps to be made, in what check, most observers at a two-hour final trial.

The official German announcement came in a letter which to the French as a major disappointment in the English and Swedish who had been hoped to be the last to make the grade and is further confirmed by the German representatives in Bonn.

Most foreign representatives in Bonn have said that the German decision would have about 100 airplanes of the new type, perhaps another 50 or so as components for German assembly, and then produce about another 100 under license. The German decision, in fact, is of its last last contractors said they planned to buy only six to 10 machines off the shelf, and to produce 100 lighter aircraft in Germany. In three years, lighter aircraft, interceptors and reconnaissance.

Approximately 400-700 General Electric J79 turbojets are involved in any prospective order of such magnitude. That would, according to the latest data, be produced in Germany jointly by heavy industry and the automobile industry, with overall management center and final assembly, most likely to go to the Riverdale Volkswagen Works (BMW). Actual license for the J79 will be taken by the West German Government rather than by industry.

There is basis for believing that the current line of credit started when a visit of the German delegation reported in Aviation Week (Oct. 13, p. 31). Most military and industry sources agree on one thing that was announced in the German press on the grounds during their discussion but none of them is a position to say. Industry representatives are afraid to state a prospective outcome, and military

officials refuse it is not their place to do so.

First report of the alleged order by Starfighters appeared following a leak to a German newspaper two weeks ago. This was almost immediately followed by an official denial appearing in the West German government's news and information bulletin on Oct. 22.

This statement said in part that the decision on equipment had not yet been made.

The German Defense Ministry called a conference for German press only on Oct. 24 and passed out a release stating that both the Super Tiger and the Starfighter were being considered, that the Mirage was not, and that one of the major selecting factors was data common to the conditions under which Lockheed would become F-104 producer to the Germans. This implied that the Starfighter would be the choice, but the release was so poorly worded, ambiguous and equivocal that it is not clear it was difficult to place much credence on any of it.

Lately, the German Defense Ministry called a second press conference for foreign reporters. They were told the release and not permitted to ask questions, according to information told to Aviation Week.

The German release said that 14 types of airplanes, three English, one Swedish, two French and eight American had been evaluated on a technical and tactical basis. The German release said that the German decision had been made.

There were the French Dassault Mirage 1A, and the two American contractors, the Starfighter and the Super

Tiger. According to the German announcement, decisions are expected around 1962 or 1963 by which time the policy will be available.

The release also added that the German press release to produce the air plane under license should serve a large part of future "rearmament" and moving from the United States.

"I can compare with the German if I try to be objective," said a USAF official. "They have to receive first enough to supply our demands and our personnel, and not fast enough to meet the demands of the Belgians, the Dutch and the French. That's not easy."

And, of course, even if they delay, they stand a better chance of getting a better airplane," added another person.

Remember that just a World War II type of air force, and they wanted not a gap of 15 years before trying to start on a modern basis with a brand-new air force. That's a tough investment, I bet you think what we would have done in the same position."

"Look, I agree," said the last official. "But even after we've done these things, we still have a long way to go."

To this extent American technical personnel in Bonn would agree. They have spent a fraction of time for the past 15 months, working for the decision. They are not sure that they will be there next spring.

## French Bitter Over Mirage Fate; Ire Centers on Germans, U.S.

By Robert E. French

Paris-French newspaper comment has privately expressed opinion among French aviation circles that the decision to buy the Mirage 1A is a bitter blow to the French. The consequence will be forced to try to sell others. If the lack of foreign orders means the Mirage will cost the Air Ministry more than planned, then the fact that France is budget could mean rejection of prototype projects now in the works.

A good deal of French criticism also is being directed at the French Air Ministry. This is because Dassault was not given permission to represent its aircraft in Bonn. French Air Ministry kept this choice to itself and as a result French aviation as the Mirage was not being rejected before the German decision.

The Mirage failure in Germany is itself wouldn't have started up so much resistance among the French except for the fact that it comes on top of several other incidents which all together is resulting in a serious French crisis vis-à-vis the U.S. and Europe.

For example the French are annoyed over what they consider to be a weakening of American anti-NATO policy on the lightening of the Mirage 1A.

The French also feel that the German decision to buy the Mirage 1A is a bitter blow to the French. The consequence will be forced to try to sell others. If the lack of foreign orders means the Mirage will cost the Air Ministry more than planned, then the fact that France is budget could mean rejection of prototype projects now in the works.

To date only the French Air Ministry has ordered 200 Mirage 1A interceptors. There is some talk in Paris that the cost of the Mirage 1A is a lot of orders now made is a lot in the French order, or at least Air Ministry reluctance to place orders on other Air Ministry plans originally called for 180 Mirage interceptors.

Effect on the French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry

French aircraft industry



# Genies, Falcons Fired in Gunnery Meet

By Philip J. Khan

Typhoon AFB, Fla.—Air Force interceptors, firing simulated Falcon and Hawk missiles, Douglas Genie (M1) atomic rockets and Mighty Mouse 275 lb. F-4A rockets for the first time in competition against each other, took part in a gunnery meet, now conducted with hits against 85% of the dummies during the intercept phase of the Air Force's sixth week-long weapons meet here. Hits are figured on the basis of motion and photographic scoring techniques.

More than 90% of the Falcons attacked by simulated Genies or Mighty Mouse rockets were located down to within planned damage, resulting in the effectiveness of these weapons against a 600 mph target which is only one tenth as large as a Genie.

Still another indication of the effectiveness of USAF's top interceptors comes and weapons was the fact that most of the hits were scored by the lead phase of the two or three aircraft that made up each team. The results of the intercepts were not as good as for previous years. For example, when F-99s, a team consisted of two aircraft, each armed with one Genie. For F-102As, three aircraft made up a team, each armed with two Falcons. The F-102D-L team composed of three aircraft, each equipped with 24 of the 275 lb F4A rockets.

Perfect score was gained by Florida

Air National Guard team, the 129th Fighter Interceptor Group, based at Col. Robert E. Denson (Angler Air Force) in the F-102D-L category when Denson and his team scored hits on each of six Genies, and the group managed to get all three of its team's aircraft for every situation.

Competition was set up according to dummy type, with no attempt to compare scores achieved by different types of weapons and weapons. Entries in the meet were three teams of F-99s, four teams of F-102As and five teams of F-102Ds and F-102Ls.

## F-102, F-99 Winners

Winner in the F-102 category was the 129th Fighter Interceptor Squadron of the Central Air Defense Force based at Hickam Air Force Base, Hawaii. Winner of the F-99 category was the 49th Fighter Interceptor Squadron of the Eastern Air Defense Force based at Griffin AFB, Texas, N.Y.

This year's interceptive competition, nicknamed Operation Winlock Top, is the first time that scores of the planes were ever fired against a dummy, even in training, and all were extremely close to the mark as the planes it provides. Although the Falcons were fired on a target course during the living test, with an attempt at extreme maneuvering as a bonus might be expected to copy, pilots agreed that it makes a more effective target than the tired

slow targets which have been used in past competitions. The Falcons were launched from a 3025, controlled by radio from ground stations near the Gulf of Mexico firing range.

Weapons meet members are credited to duplicate tactical usage as closely as possible. Intercepting pilots are given a 30-second alert, assembled by the team's own ground controller to intercept (GCI) operations when he picks up the undetected Falcons as he ground radar scope.

The GCI operator then vectors the team's aircraft, using voice radio, to meet the target and hit. They are within range where their own defense intercept radar can lock onto the target. GCI operator is considered a vital, important member of the team because he does determine whether the aircraft can maintain a constant position to intercept the target.

The F-102As and F-102Ds and La ruse involved attacks on the Falcons, which the F-99s simply downed attacks. The head-on attack is used because the Genie rocket has a large lethal radius, and not such a direct hit under control conditions.

The high degree of reliability achieved by the weapons fire against motion and on the three aircraft types and the high percentage of hits scored by the Falcons, indicate that the Air Force has begun to master the problem of accurate air-to-air combat in its present generation of aircraft.

Consensus with representatives of competing teams indicates that the Falcons, developed and produced by Hughes Aircraft Co., has become a versatile reliable weapon and one which Air Force maintenance personnel can handle. Air Force maintenance personnel get a major asset from an aircraft that can be developed by the Hughes which is now installed in nearly every base that uses the Falcons. With this console, USAF maintenance personnel can quickly check out each Falcon to factory standards and replace missiles to the major sub-system.

Reliability of the fire control system used on all three interceptors, which was developed by Hughes and produced by Hughes and Rando Corp. of America, has shown major improvements in the past 15 months, all teams reported. However, it is considered an acceptable that the Falcons and requires more maintenance.

During the 72 missions flown by 12 teams in this meet, there were 140 or more reports of fire control system malfunctions. Most teams conclude, however, that performance of vehicles is actually used here is somewhat better than the normal "back home" per-

formance. For example, with their last maintenance performed working on the engine control in the most advance status are able to look onto the target of nearly 1000 yards range than under most operating conditions most teams report.

The target dummies, which pose a problem that makes it to be measured and scored, has been in many as 19 scenarios before being destroyed and with average scored five minutes. Personnel survival average has been high at this meet, although damaged stores are removed whenever possible by host in helicopter and removed for visible parts and scoring purposes. The record time-distance of the Falcons in Genie in order to determine whether to destroy a dummy, but the Falcons comes in average against a system known as PARAME, short for Paramechanical Range-Airborne Man Indicator. System operates somewhat like the familiar distance measuring equipment (DME).

## Falcons, Genie Scoring

Each Falcon or Genie carries a small transponder in place of a missile. As the missile or rocket approaches the target, an intercepter in the Falcon transmits a pulse, which activates the transponder in the missile or rocket, causing it to transmit a reply pulse. From transmission of first pulse and receipt of reply indicates the distance between the weapon and target. For scoring, Mighty Mouse rockets, which are too small to carry a transponder, Falcons is equipped with a motion picture camera. Film is automatically advanced to determine exact distance when drive is located down to target hit.

For the Genies, Mouse rockets, any one that comes within 35 ft. of the dummy is considered a hit since the nearest located target is considerably larger. For Falcons, which are equipped with a proximity fuse, a score is made every 200 ft. a score is a primary hit, while one that comes within 35 to 45 ft. is considered a secondary hit, making eight down points. For Genie up to 500 ft. is considered a primary hit while 500 to 1,000 ft. is a secondary.

Perhaps the most surprising of the team members at this year's meet was the use of information to enable thousands of visitors and team members on the ground to view the GCI radar scope of periodic missions during each mission, in time to give instructions. The sponsor and pilot and to actually watch the interceptors make an attack on a dummy plane firing a television camera.

The F-102, equipped with miniature television TV console, developed by Dug Television Division of Thompson Products, served in these planes. Signal



Ike's Visit Brings Titan Photo Release

First official photograph of Titan submersible made was taken during President Eisenhower's visit into the waters of a Genie plane and test, although the exact configuration of Titan was disclosed last March. This photo was released last week with White House approval. The 90 ft. missile is due for launch from Air Force Missile Test Center in Florida within the next few weeks. Despite the release of this picture, Defense Department and its policy of refusing to show pictures of the missile, and after the Titan, will hold. Titan Titan picture here appeared in Aviation Week on July 18 (p. 19) and Sept. 1 (p. 31).

was transmitted to the base here, then broadcast by means of a long-range radio transmitter to dozens of Titan TV screens located around the base in individual team trailers, at the officers' club and other sites.

Another television camera mounted near the mission taught the interceptors in brief and brief, although viewed the submersible as new results were called. An Air Force member presented a training memorandum that would have been made to a major network as the mission was watched from the rear, to the GCI radar scope, to the three planes on fire range 150 or more.

This is believed to be the first time that television has been used to monitor interceptors and the subject is opened suggests it may find increasing use for tactical operations as well.

## Sikorsky Cuts Force By 1,100 Employees

Stratford, Conn.—Sikorsky Aircraft Division of United Aircraft Corp. announced plans last week to reduce its work force by 1,100 employees before April generally because of declining production schedules.

The cuts will reduce Sikorsky's work force from approximately 9,500 to 8,400.

The division's plant employment reached last year's level of 11,000. R. S. Johnston, Sikorsky general manager, said, "The decline in the volume of business for 1954 is the result primarily of the national program initiated by the Department of Defense several months ago."



# Europe May Make Hawk Under Aid Plan

By Katherine Johnson

Washington—Negotiations for production of the Army/Northrop Hawk light-attack or defense missile in Europe have reached an advanced stage. Production of the Hawk is expected to be the first project under a program the U.S. is beginning this year to develop manufacturing facilities for advanced weapons in allied countries and lessen their need for U.S. aid.

Under present plans, various components of the Hawk will be produced in seven countries, which in turn would produce the missile for three military forces. Countries expected to participate in the program are France, Italy, Germany, Belgium and the Netherlands.

U.S. has committed \$23 million for the "facilities assistance" program to help Europe with the production of advanced weapons it needs for its own defense.

U.S. plans to supply such items as machine tools, gages, dies, mechanical engineering drawings. Most of the projects will be for other weapons, such as the A-10, in the program as well as to include Japan.

U.S.'s defense aid program for Fiscal 1979, developed by Charles H. Studd, Deputy Assistant Secretary of Defense for Military Assistance Programs, reflects an increase in advanced weapon systems as well as the introduction of advanced facilities.

Here are the highlights of the Fiscal 1979 program.

• **Missiles.** There will be between \$200 million and \$250 million to finance new missiles. The Japan intercontinental range ballistic missile—which probably will go to Italy—is in the program. The IRBM's for Great Britain already have been financed. Defense Department originally projected a \$213 million missile program for 1979. This included \$17 million for the British Command or Support missile, \$49 million for Lance missile, \$95 million for Hawk missile, \$44 million for Taurus surface-to-air missile, \$41 million for Silverdust air-to-air missile, \$10 million for French SS-16 anti-tank missile. A revised program is now being reviewed by State Department.

Fiscal 1979 fiscal limited orders for Nike anti-aircraft missile \$222 million, Hornet John battle missile (\$56 million) and Silverdust, Command, Support, and SS-16 missiles (\$34 million for the first type).

• **Aircraft.** New orders will be approximately \$215 million. New orders for F-106 supersonic fighters and Convair 580 twin subsonic fighter aircraft are

in the program. A reworked F-106 will have funding for F-106 in the Fiscal 1979 program was postponed to finance. This purchase. Negotiations are now under way to include the Fiat C-91 light-weight fighter in the program.

• **Armored.** New orders will amount to approximately \$52 million—about 90% to finance improvements in USAF ground control approach, airborne radio equipment and aircraft control and warning systems. About \$23 million will be used to purchase the Air Force for aircraft control and warning systems and airborne communications equipment which is being turned over to Japan for operations by Japanese forces.

• **Weapon development.** A total of \$40 million is tentatively allocated for this continuing program under which the G-1, SS-16 and a number of other weapons have been developed. U.S. is expected to continue contribution to development of a British intermediate range ballistic missile by de Havilland Avro.

• **Defense procurement.** This program of foreign purchases, largely to bolster the economies of allies, is declining rapidly. Orders during Fiscal 1979 will drop below \$100 million as compared with \$116 million in Fiscal 1978. The decline, according to Studd, is due to changing national requirements and "the vital need for striking orders in the U.S. to sustain the domestic military production base." Defense procurement is now primarily restricted to items which must be of foreign type to support foreign equipment and items so bought produced in the U.S. It is now official policy that no defense procurement will be undertaken if it will "in any way reduce or affect the U.S. production base or (2) result in exportable price differentials in comparison with U.S. supply of similar items."

• **Foreign aid.** U.S. exports to finance \$100 million in weapon sales to foreign countries in Fiscal 1979 with its credit extension program. Thus far, most sales of military equipment by 60 countries and non-aligned organizations have been for cash. Almost two-thirds of the sales have been to Canada and Germany. However, Defense Department estimates that extension credit will make possible \$168 million in potential sales during Fiscal 1979 to such countries as Australia, New Zealand, Venezuela and other Latin American countries. Approximately \$77 million in Fiscal 1979 defense assistance from the U.S. have been set aside for credit to allies who want to purchase U.S. material to

meet the objects of mutual security. Defense Department reports on the cost of mutual military security assistance from October 1950 through October 1977 include:

- U.S. military contributions to other countries totaled \$197 billion. Cost for U.S. foreign defense forces amounted to \$277 billion. Total U.S. allocation to mutual defense was \$796 billion.
- After receiving U.S. aid spent \$105 billion on their own defense. Canada and Australia, which have not received U.S. assistance, spent another \$17 billion. This brings the total cost of mutual defense against the Soviet bloc for the eight-year period to \$415 billion.

## Navy Plans Increase In Polaris Range

Datta—Range of the U.S. Navy submarine-launched Polaris intermediate range ballistic missile actually will be increased beyond its present 1,500 mi. limit, Rear Adm. William T. Datta, Polaris program chief told a Navy Day meeting of the Navy League here.

Discussing the missile's capabilities, Admiral Roberts said "1,500 mi. is but a first step. This stage, like about any other missile, will be improved." Recent operations of nuclear-powered submarines under the polar ice pack have demonstrated that manufacturing, maintenance and seaworthiness of the nuclear warheads of the Soviet Union.

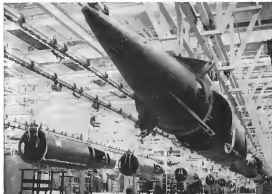
Commenting on an observation that these operations were conducted in the summer months, Admiral Roberts said he is "not disappointed" over prospects for a polar ice missile launch under the most difficult conditions of the winter period.

The Admiral observed that the Russians have a highly developed intelligence capability and have intermediate range ballistic missiles, and that they are presently planning to state the two reasons.

But he said he believes the U.S. is ahead of the USSR in development of long range solid propellant missiles and in the job of combining them with nuclear-powered submarines.

Polaris has had two spectacular failures recently at Cape Canaveral, Fla., but Admiral Roberts reported that out of 23 test flights, 21 have been successful.

Components which caused the failures were under repair, he said, and can be corrected by reengineering certain features.



Nike Hercules in final assembly conversion line in complete except for launch and structural section which goes on gage (above) between nose and body. Independently actuated control fins are checked out (below, right) and then removed to make room through assembly.

## Nike Hercules Assembly Shown for First Time

Douglas Aircraft Co. is now near full extension of its Charlotte facilities for the production of Nike Hercules. Actual production figures are classified but other than the missile in test missiles, Nike Hercules output here is believed to be the greatest of any major missile production in the U.S. At present, the Charlotte Division employs more than 2,800 people on a one shift basis on a limited basis capacity would be doubled according to Donald Dwyer, Jr., and no a Hercules line it could be increased by a factor of 1.5.



Painted and ready to move to missile substation, Nike Hercules missiles are disassembled, nose is inserted into back of the body section and then placed in a shipping container and loaded on flat cars.







**B-52G Missile Carrier Makes First Flight**

Bombing B-52G, now in quantity production at Wichita, Kan., will soon enter service with USAF Strategic Air Command. Bomber made first flight at McClellan AFB, Wichita, flying at 7 min. on a mission which included an aerial refueling 'boop-ple'.

## Industry Wins U.S. Property Tax Round

Los Angeles—Attempts by California counties and cities to levy partial property tax on U.S.-owned equipment and inventory in aviation industries formerly have not been ended by a ruling of the California Supreme Court that such taxes are generally illegal.

The court has ruled that as California statute specifically authorizes local governments to assess and tax the personal property of private parties, it forbids personal property such as tools and work-in-process inventory which they are using or which is kept in their plants.

### Bid for Refueling

Local government law authorities hold little hope that they had for a rehearing by the State Supreme Court will be granted since the first decision was unanimous.

There now more will be to seek the passage of a law by the California Legislature authorizing the tax. There appears to be no legal obstacle in the

law since the U. S. Supreme Court ruled in the case of the City of Detroit vs. Maier Corp. that no constitutional right is violated when a local government levies a partial property tax on local-owned property in general property to which the federal government holds a valid title.

A California law already exists which enables local governments to tax the personal property interest of contractors in U.S.-owned and payable assets they own. Another U. S. Supreme Court decision supports this law.

When the local governments take that proposed law to the Legislature they can expect a more fight from industry, since many existing contracts make no allowance for an increase in the price of the product due to the imposition of a new tax after the contract signing.

Los Angeles, San Diego and Alameda counties and the cities of Long Beach and Pomona were among the earliest to claim the tax. It was first

applied in 1953. The recent decision by the California Supreme Court that the tax is illegal was the final outcome of a long battle brought in 1954 by Armstrong-Corpus Corp. against Los Angeles County and the City of Los Angeles and General Dynamics Corp. against Los Angeles County and the City of Pomona.

### Los Angeles Declines

The tax was first called illegal in a decision on the case handed down by the Los Angeles Superior Court on Jan. 10, 1957, and later appealed by the defendants to the State Supreme Court. When the plaintiffs originally filed suit, taxes collected on the disputed basis were imposed amounting to the demand of the courts. However, in Los Angeles County for the years 1955 and 1956 the taxes were released and partially spent on 1956.

The request was not acted upon by the Superior Court's decision and the county has later reported to be sitting aside money to

a reported rate of \$3 million per year to rebuild the suspended fund.

In Los Angeles County, also, total amount of the refund to industry is expected to be between \$50 million and \$65 million. By 1957, several hundred companies, including small revenue firms and other subcontractors, will be lined up for their U. S.-owned inventories and equipment. Most of the taxes were actually paid by the Department of Defense which allowed them at reimbursable costs on defense equipment and most aircraft will go back to the government. Department of Defense has always held the tax illegal and instructed contractors to file for refund of the taxes paid in fiscal years 1954, 1955 and 1956. After the 1957 Supreme Court decision, the Department of Defense stopped reimbursement for personal property but on government property has reimbursed contractors on a relatively small part of the total.

Until the Supreme Court decision, local governments also were levying defense contractors on the U. S.-owned inventory and equipment kept in the plants of their subcontractors.

The U. S. Supreme Court last week refused to review a ruling of the highest court in Kansas which denied the state the right to tax government-owned equipment and machinery which General Motors used under a USAP contract. The court held that the property was owned of all taxes by the government and was therefore immune from direct state taxation even though General Motors used the equipment.

## High-Density Trend Emphasized in An-10

Moscow—Russian trend toward high-density seating arrangements in conventional transport is emphasized by the new An-10, an advanced version of the four turbo-prop An-10 Ulinast.

Latest version of the transport designed strength acceptable accommodation 118 passengers as compared with 150 for the An-10A and 84 for the original An-10.

Current program in developing higher density aircraft has been most significant with the Tu-104 series. First of the Tu-104s entered 50 passengers while later designs of the 104A carried 70 and the 104B series 100.

## SC-1 Pure-Jet VTOL Makes First Flight

London—First free vertical take-off and landing was made Oct. 25 by the Short SC-1, Short Bros and Harland Ltd.'s pure jet research aircraft sponsored by Ministry of Supply.

## Space Technology

## NASA Invites Bids on Capsule

Washington—Bids leading to the first U. S. manned sub-orbital capsule have been opened to industry by National Aeronautics and Space Administration. Bidders conference is set for Nov. 7 at Langley Research Center, Langley Field, Va. Proposals are due by Dec. 4.

Project will be managed by Robert R. Colvins and done with the assistance of Defense Department's Advanced Research Projects Agency. Its goal is to put a man into orbit, study his flight and return him safely at "the earliest practicable date."

This project, along with other new NASA work and projects that have been transferred from the Defense Department will be handled in accordance with the Armed Services Procurement Act.

### Procurement and Contracting

NASA Director T. Keith Glennan said last week that his agency is developing procurement and contracting regulations that "will conform to current practice" with Armed Services Procurement Regulations. This will be, he said, in order to facilitate a change-over on transferred projects and the necessity of operating under two different sets of regulations for contractors doing business with both the National Aeronautics and Space Administration

and the various military services.

The space agency plans a major procurement and contracting program. Although it will continue to buy services, materials and equipment from thousands of the old National Advisory Committee for Aeronautics, Glennan and S. Doolittle said to develop and use contractors' resources capable of designing, developing, producing and testing space vehicles and the supporting services and products related to the successful launching and operation of such vehicles.

The agency said it will do the following:

- Advertise in competitive bids whenever requirements can be clearly defined, and award contracts on a fixed price basis to the lowest responsible bidder.
- Use the negotiation method with qualified firms when product or service requirements cannot be precisely defined, and award contracts on a fixed price or cost plus fixed fee basis. Most of these negotiations will be for research or development contracts.
- Negotiate contracts with educational and other non-profit organizations for specialized research and development.
- Give small business firms as much opportunity to participate in contracting as practicable, consistent with NASA's goals.

## PanAm Completes Jet Financing

New York—Four American Airways last week obtained a \$130 million revolving line of credit under highly favorable terms from a group of banks in 17 cities, completing the financing necessary for its jet aircraft on order.

Pan American was close on the line of credit from new stock sold \$50,000, at price \$100 per share, after the line from the banks is made. After the sale, Pan Am's total debt will be \$130 million, less \$50 million in cash and \$30 million in five years. The revolving line of credit permits Pan Am to borrow, repay and re-borrow. Thus Pan Am can actually obtain more than \$130 million in loans over a long time even though the total bank commitments at any one time could not exceed \$130 million.

First American jet orders for 17 Boeing 707-120 International, on 707-120A and 17 DC-8-62 total \$290 million. First order DC-8s for order for Pan Am to itself \$10 million for a total of \$200 million. Pan Am has an \$80 million in long term loans from insurance companies in addition to its line of bank credit, and deposits of \$15 million have been paid.

Several factors influenced banks in granting the Boeing terms. One was Pan Am's "has always treated its bankers well" as the post. Another is the long track record of Pan Am's depreciation of equipment. Cash business points are considerably lower than bookkeeping depreciation points. Thus airlines could be in the awkward position of reporting revenues flat, of reporting huge deficits because of the high depreciation deductions they must record and still have ample cash to pay their bills.

Another possible factor in the banks' attitude may have been American Airlines' buying of engines rather than borrowing for purchase. Some bankers have been critical of this move and competitive reasons may have prompted a drive for Pan Am's financing.







and visual engine component life. Warning that rising of turbine engine loads could likely not only be the going, although it said there has been ample evidence that had and also has as adverse effect on performance. In other words, the committee found that the higher power engine component present special problems in the performance of it. It added, however, that for certain engine conditions, traditional methods such as stress method may be required but are considered as inadequate.

The committee pushed the Doppler radar navigation system which it viewed of "great significance to operators" and added:

"While Doppler systems must undergo further evaluation, it has already been possible to evaluate a new navigation philosophy based on its accuracy, safety and ease of use. The advantages of Doppler radar navigation with its self-aligning, self-correcting and self-referenced aircraft navigation with out requiring ground stations."

The committee found that radar navigation actually operations will come as an inevitable part of the future, but "will require existing costs." It reported a need for improved quality for radar communications and for radar data data transmission for system communications.

Continued research into jet stream and cross air turbulence are urged by the committee which emphasized the close relationship between finding the cause and the effect and the accuracy of forecasting these elements. This relationship calls for improved accuracy in weather forecasting and new electronic methods of information the committee told the assembly.

On airport buildings and signs, the committee made three recommendations:

- **Maximizing of turbine research on the signs should be carried out under their own policy.**
- **Threatening is desirable where large quantities of fuel are to be supplied to turbine-powered aircraft in a short time.**
- **Fire fighter stations must have adequate equipment when aircraft cannot be parked next to terminal buildings.** The committee strongly recommended against a sign system which:
- **Use of passenger-carrying vehicles will be even more available with air data with propeller planes.**

ATA members were given a report of progress made toward eliminating a type of engine component which may delay the development of more efficient turbine.

On major aviation in reflecting the burden of taxation, investigation and public facility programs, the committee found that the government should maintain the report said. Straps to

## United's Earnings Rise

United Airlines reported increased earnings for both the third quarter and for the first nine months of the year. The figures:

- **Third quarter:** \$14,880,710 or 35.5¢ a share this year compared to \$7,516,174 or 33.4¢ a share last year. Of this, \$12,219,219 was a non-recurring item from sale of aircraft equipment with \$2,661,491 for a similar category last year.
- **Quarterly earnings:** were \$4,968,234 this year, or \$17.8 a share, compared with \$4,968,132 last year.

Non-aeronautics income rose 105%, to \$214,499,791, while operating expenses rose 75%, to \$215,550,480. United announced a continued expansion of traffic in October, after the end of the third quarter, as business conditions improved.

United President, W. A. Patterson said that the improved position still did not ensure the need for higher fares to bring earnings back to levels in past United's assets and past revenues. A full Patterson said the period on one issue of increased earnings, \$214,499,791 was a Civil Aeronautics Board accounting policy. This accounting policy of a 1958 value of the previous 1957 and this reduced United's disposition expense by that figure.

The U.S. government and airlines also as a result of dropping the maximum requirement is estimated to be \$1 million annually, this report said.

Airline passengers held a summary of the technical committee's report on its conference held in September in Monte Carlo. Furthering committee objectives, the introduction of technology was the first point of discussion during the entire conference proceedings.

## Foreign Test Dispute

It was generally accepted by manufacturers that power derating of an aircraft could be required to check for fatigue and not necessarily for structural strength. It is now where the results of a major nature had been confirmed.

One airline said it believed that the fatigue should never be tested to aviation permissible pressure, adding that it was proposed to make operational services in obstacle of normal flights other than combat training which might lower the fatigue life of the airplane.

Some delegates, however, suggested that testing to maximum pressure might prevent the structure and actually improve fatigue life. One manufacturer recommended that aircraft should be subjected to proof pressure at least once a year.

Sharp derating of engine capacity currently among manufacturers on the basis of testing requirements rather than complete, including fatigue, inspections. Airlines held no opinion on the subject but urged the manufacturer to make the differences as much as possible.

Airlines also called for greater freedom. The manufacturers in developing inspection periods for the jet transports.

Airlines focused point concerns on top surface of aircraft as a data point for inspection. Both and relevant parts. Manufacturers urged full test procedures but stressed against the use of point inspection on aircraft using stress, vibration.

On the point of this concern, the group discussed extensively the problem of new aluminum alloys and new materials used in structural components. Airlines were in general agreement that they did not feel suggestions under air controllers but that they considered an alternative would create a weight penalty. Manufacturers said that they were in fact aircraft are being used with new materials, which are able to improve and more. Both sides issue to confederations. A new scheduling process for inspection has proved to be successful but has not yet prevented the possibility of lack of inspection, a starting point for further concern.

On engine engine power derating and restoration, the technical committee found that engine derating is a starting technique, operating conditions, this report said. The engine derating is existing derating. Power derating is the loss of efficiency of one or more components of the engine during a reduction of power below the rated power under standard conditions.

Airlines with some backup experts once indicated that power derating has a weak engine proposition although there has been some discussion in this area within the past year.

One airline said it used the following technique in a series of testing power derating technique. This aircraft derating is not a test of engine power but a test of engine power. The aircraft derating is not a test of engine power but a test of engine power. The aircraft derating is not a test of engine power but a test of engine power.

Time engine power derating is intended as a means of isolating power derating—load testing at that intervals for smaller engines and clearing of larger engines with a special test jet.

One manufacturer indicated that a

small derating is in power of maximum rpm, with a two speed engine would cause a power loss of 7%. Loss was detected by engine of a test engine. The engine derating is a test engine. It was argued that which derating due to contamination had been a limiting factor in engine life up to now, it is difficult to predict. The engine derating is a test engine. It was argued that which derating due to contamination would have an engine with more than a 2,000 h life. It was suggested that eventually it might be less expensive to accept some power derating than it could be to make an aircraft tests to clear the contamination.

Other points reported by the technical committee in assessing expert attention:

- **Need for full utilization of aircraft wings during bleed.**
- **Requirement for a more accurate air flow control.** The committee reported that power derating aircraft on land or in flight, which is a test engine. During operation, the instrument in present aircraft has a three degree error.

## CAB Counsel Urges Cuts in Fares

By Robert H. Cook

Washington—The Civil Aeronautics Board's Bureau of Cost Work has announced airline fare cuts totaling \$467.5 million the next two years as its based on the General Passenger Fare Investigation.

The council's third report directly resulted in airline demands for an increase ranging from 12 to 17% which they consider necessary to attract the financing needed for the jet transport program. It also reflects recent CAB statements that airline fares are the only means of tilting the scale in favor of airlines.

As presented in a brief to CAB Executive Ralph E. O'Connor, the Bureau counsel urged a 1.31% fare cut in the first decision in the two-year fare cut and a second reduction of 6.15% by July 1, 1960, when the bulk of jet transports now on order will be placed in service.

## Leisure Income

A primary airline fare increase of 6.65% should be dropped to only 4% and the CAB, 20% increase of 1.45%, making from the chairman and reduction of many discount plans, should be repealed, the bureau counsel said. The chairman indicated would still reduce fares 1% above those of last year, the brief added.

Urging CAB approval of fare cuts, attorneys for the Air Transport Association urged the airline's financial position. They said the need 6.65%

The committee noted that this will be increased in line with the airline's financial position.

• **Need for more engine maintenance on the amount and area of solid engine matter that is contained as possible to reduce engine.** Manufacturers now asked to establish clean standards for solid engine.

• **Airlines agreed that threat suspension by state inspection will improve engine performance and pointed out that they will make such new problems in the need for engine and engine a high, corrosion and engine on turbine.**

• **Manufacturers should be requested to supply large turbines with standard blades.** Airlines indicated that considerable work will be done in the development of thrust jet engines and that the United Kingdom aviation authorities are planning to develop testing derating requirements a while the three engine manufacturers are working on the derating testing, the instrument is present aircraft has a three degree error.

• **Need for full utilization of aircraft wings during bleed.**

• **Requirement for a more accurate air flow control.**

• **Need for full utilization of aircraft wings during bleed.**

• **Requirement for a more accurate air flow control.**

• **Need for full utilization of aircraft wings during bleed.**

• **Requirement for a more accurate air flow control.**

• **Need for full utilization of aircraft wings during bleed.**

• **Requirement for a more accurate air flow control.**

ment program brings on the matter of higher fares the brief said, citing financial statements on "conditions" credit approval, capital work, the aircraft. ATA reported that one of the largest financial institutions with credit agencies holding more than \$150 million and no other recently has refused to finance aircraft equipment. ATA said that for bank loans for jet aircraft amount of \$100 million. A question was for the institution further stressed that the "brief that credit agencies can be easily financially arranged for the money they will need to pay for jet aircraft is false since since they have only arranged for it at their request during the year 1958 through 1960 substantial additional equity capital."

Factors in the way of the requested increases in face of airport jet large scale jet operations and the problem of inflation, will only come as a result of credit restrictions, the ATA brief said. It added that the cost of the refinancing impact on the industry and how it may become more more was illustrated by the cost of purchase and installation of electronic equipment in a 1945 propeller-driven aircraft.

In 1958, the cost was \$12,500, as compared with \$97,000 for the same job now. Initial cost per horsepower of engine has advanced in a like ratio. ATA said—\$10 for the DC-3, \$11.5 for the DC-4, \$19 for the DC-6 and \$28 for the DC-8.

ATA brief

The ATA brief, while agreeing that jet engines are based on, warned that:

"It is quite conceivable that jet engine more expensive to operate, at least for a time." The attorneys added that the next jet engine could be years of "breakdown" in the maintenance of the engine. The engine derating is a test engine. It was argued that which derating due to contamination would have an engine with more than a 2,000 h life. It was suggested that eventually it might be less expensive to accept some power derating than it could be to make an aircraft tests to clear the contamination.

ATA brief

The ATA brief, while agreeing that jet engines are based on, warned that:

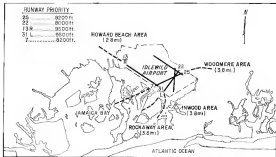
"It is quite conceivable that jet engine more expensive to operate, at least for a time." The attorneys added that the next jet engine could be years of "breakdown" in the maintenance of the engine. The engine derating is a test engine. It was argued that which derating due to contamination would have an engine with more than a 2,000 h life. It was suggested that eventually it might be less expensive to accept some power derating than it could be to make an aircraft tests to clear the contamination.

## PanAm Personal Cut

Washington—Pan American World Airways last week announced a 1% cut in fares in Miami, pointing out that this is the lowest competitive rates in the industry. The airline is now developing a Latin America (LAT) cut in 1%.

The airline said the airline would be a big increase in the number of U.S. and foreign airlines serving Latin America over the past few years and the fare cuts now being offered by some airlines.





ATIS at N.Y. International Airport are confined to above runway except by special N.Y. Port Authority permission. Deferred flows from runway ends appropriate where there are obstacles for after takeoff. Extension of runway 7/25 and 13R/13L will be completed soon.

## Operating Snags Figure in Jet Service

By Gloria Carrasco

New York—Opening of the U.S. jet age last week with the first Pan American Airways commercial Boeing 707 flight was marred by restrictions and problems still facing the airline and other operators hoping to make the most of their expensive modern turbine fleets.

• **Pan American's daily New York-Pitt** Boeing 707 schedule, billed as non-stop, actually acts stopping for fuel because of runway limitations and air-traffic regulations of the Port of New York Authority. Situation will improve greatly during the next two months as various extensions are completed at Idlewild, but won't be until at least the International 707 is delivered.

• **Unsettled crew disputes** are facing Pan American's air operators who on the transatlantic schedule. Under agreement with pilots it concluded before Nov. 16, New York-London service will be postponed as reduced from daily flights. Eastern Air Lines, planning introduction of turboprop Lark, had, Electro next month, and American Airlines, set for January introduction of 707s and Electra soon after, face the same crew-related problems with their turbine jets.

• **Surcharging at Rome** has been imposed on jet operations, causing Pan American to temporarily abandon jet service

to that city and substitute piston aircraft between Paris and Rome. British Overseas Airways Corp., holder of the transatlantic jet first through transportation of the new Idlewild Contract 4 use-on Oct. 4, ran into labor difficulties and has cancelled most of its weekly New York-London jet roundtrips. The airline hopes to get its delayed crew training program completed in time for daily Coast service beginning Nov. 14.

Pan American's 707-71 is not, of course, a true transatlantic nonstop airplane, as the airline is ready to deliver Part 66, or Whizzer, 714 (715) powered turbofan-engine 707-121s to meet initial deliveries expected next summer, will fill this requirement.

But the 713 (717) powered 121s will be able to make it only at a percentage of the time within the next month or two, when two Idlewild runway extensions are completed. Meanwhile, the planes are limited by a combination of runway length and noise restriction factors which will permit very few nonstop operations, these only when all conditions are favorable.

Here is the breakdown of Idlewild's runway situation, considering each step in the order of priority had been by the Port Authority, for its use by jet aircraft.

• **Runway 25 is mandatory first choice**, 8,200 ft long and paved out over Jacques Bay with no construction under a takeoff flight path. We take off from this runway at full gross weight of 247,000 lb, the 141 would need 7½ ft of headroom on a 325 ft deep. Transatlantic nonstop requires a gross weight, generally speaking, in the neighborhood of 233,000 lb, allowing a full load of 311 passengers, little cargo and fuel, and approximately 90,000 lb of fuel on the average. For takeoff at more than 740,000 ft on a 325 ft deep, 2½ ft of headroom would be required. This runway is being extended to 10,000 ft, and under zero wind conditions, full gross takeoff will then be possible when temperature is below 59°.

• **Runway 22** can be used in lots of 25, in which case a night takeoff is called for as soon as practicable to avoid flying directly over communities. This runway is only 5,000 ft long, a close-in wind direction to 25, and when 25 is extended, will be used only when the airplane is taking off light enough.

• **Runway 13R is the only east-west runway** capable of use for the 707. Even with a night takeoff, the plane can go to 3,200 ft at 247,000 lb gross by the time it reaches Inwood. This constrains it to 3½ mi from the point where takeoff roll starts, and it is in an area including other local airports such as Garden and Lawrence. Runway

13R/13L is being extended to 11,200 ft. Right turn after takeoff is specified by the airline.

• **Runway 31L is out for full-land use**, because the airplane can't get to 3,000 ft by the time it reaches Inwood Beach. 2½ mi from start of takeoff, the 1,700-ft extension will help a little, but not much. Right turn is called for after takeoff.

• **Runway 7 is restricted to about 100,000 lb less than its opposite end**, Runway 25. Extension won't improve the situation at the 7 end, because climb for 3,200 ft over the Woodhams area, 1½ mi from start of takeoff, will require the more weight. Inwood Beach is an exposed after takeoff.

On a press flight Oct. 25 before start of scheduled service, Pan American made it nonstop to London with 115 people aboard, but on hours 47 min. Concentration happened to be such that Runway 13R could be used under the preferential system.

The best scheduled flight would have been covering both for the Port Authority's rules. Runway 31L was in use by office traffic at the field, and the 707 could have used the 9,800 ft strip with no restricted climb conditions it could have made it. Another hoped for a last minute wind shift that would have allowed it to use 11R, but was finally forced to use 25 as the mandatory jet runway, with ensuing wind conditions.

So it took off at 237,000 lb, including 51,700 lb of fuel, and stopped at Garden. Elapsed time, 3 hr, 51 min. block to block, with 1½ hr in the ground at Garden.

Second and third American nonstop flights took off from 25, at weights at 211,000 lb and 200,400 lb, respectively. Second flight dropped at Garden, while Frontier's flight stopped both at Coast Bay and London.

First rescheduled scheduled flight stopped at Keflavik, after taking off from 25. Runway's 7,000 ft extension, scheduled for Idlewild in an expanded block time of 10 hr, 25 min including ground time of 1 hr, 5 min.

Ground times at intermediate stops are being improved with pistons, and the airline hopes to get the time down to 38 min.

At an indication of the economic penalty of stopping, Pan Am contrasts the direct route to Paris, past Garden at 51,800, including landing charges and fuel used in landing down and climbing out again. Intangibles such as changing water add considerably to the penalty.

Another penalty imposed by the need to climb to 1,200 ft quickly is the extra water that must be carried for cabin altitude. For example, at 179 and 740,000 lb gross, with sea level wind, it would take 2½ min to climb to 1,200 ft during takeoff and initial climb.

On any jet service last 25 at Idlewild, this requirement would go up to 3,200 ft, under the same conditions. A 100 ft drop of the same weight, 4,995 lb of water would be used in the quick climb operation.

Pan American plans to add daily service to London on Nov. 16, but if no contract is signed with its pilots, this won't be possible. Alternatives in such a case would be to serve both London and Paris with fewer aircraft, or schedule only with daily flights.

Problem of Rome is a surprise for Italian authorities have decided to get on commercial jet flights. According to Pan American, the surcharge is to the tune of a percentage of total cost of each flight. The airline says it is not negotiating the point because it doesn't feel there is any probability for a surcharge. The fee reportedly suggested by the Italians was 1.95¢, and it came down to something like 1.75¢, perhaps Pan Am might accept.

The pilot problem is haunting American and Eastern as well as Pan Am. Eastern's dispute with the pilots has gone back to the National Mediation Board with the third crewman out of pilot qualified to mechanic-qualified engineers the scheduling block. The airline has accused two inspectors, Lucien Blevins, who are now at Miami. But the rank and file Eastern pilots are not taking flight hours until the dispute is settled. Airline hopes to start Eastern service Dec. 3, at which time it will have secured about eight new pilots. New pilots are being trained in regular jobs in the domestic branch at Idlewild. Best job is north at the end of a finger 710 ft, cut from the terminal in the second five American airlines are in, it is hoped to get in, would land, in the terminal, loaded and loaded again. Airline has suggested to the Port Authority that blue gates be needed along the walkway, and that it be moved to end of boarding stairs for jet flights at Idlewild located along a finger considerably out from the terminal.

First American 707 has a provisional certificate of airworthiness, but it is being certified so that jet operators can be put ahead for training and transatlantic flight. Configuration will be 36 first class, two ahead, 35 lower deck. Seats will be in rows off sections of the airplane respectively. Interior of the general aircraft that is not work, without seats in its own bulk, shortened the size of the 707 compared with piston aircraft.

Between the time of the first flight with forward and aft lavatories. New window in American's interior passenger service pods above with window between "no smoking" and "fasten seat belt" signs. The window is the seat behind, replacing conventional signs.

day, one window ahead, stopped at Garden and the other at Keflavik. The British carrier is a de Havilland jet and also Miami flight passenger told 85. Some configuration 16, 11 and 12 first, will apply when daily service is started.

DOE is now operating about shorting daily service on schedule Nov. 14. It had feared that a strike of engineering and maintenance personnel at London Airport, which began Oct. 13 and ended Oct. 21, would delay the new schedule. The airline now feels that if anything happens to interfere with a stoppage training schedule it could cause close enough to the goal of 100 jet aircraft in total fleet of the airline with the service. The strike cost BOAC an estimated 52½ million including loss of revenue and shuffling of passengers in chartered planes and on other airlines.

Plans with Coast 2 operator—the only ones being trained—include 12 at 14 in the Coast 4. Training flights are being held every day with all of the four Coast BOAC pilots, but it is possible that the National Mediation Board will schedule transatlantic flights, and it seemed unlikely last week that the weekly service would be resumed.

Wage negotiations with the pilots, who the much have not been completed, pending completion of a report of inquiry investigation into the general question of labor-management relations at London Airport.

Pan American's daily flight departing New York are being limited from regular gates in the domestic terminal at Idlewild. Best gate is north at the end of a finger 710 ft, cut from the terminal in the second five American airlines are in, it is hoped to get in, would land, in the terminal, loaded and loaded again. Airline has suggested to the Port Authority that blue gates be needed along the walkway, and that it be moved to end of boarding stairs for jet flights at Idlewild located along a finger considerably out from the terminal.

First American 707 has a provisional certificate of airworthiness, but it is being certified so that jet operators can be put ahead for training and transatlantic flight. Configuration will be 36 first class, two ahead, 35 lower deck. Seats will be in rows off sections of the airplane respectively. Interior of the general aircraft that is not work, without seats in its own bulk, shortened the size of the 707 compared with piston aircraft.

Between the time of the first flight with forward and aft lavatories. New window in American's interior passenger service pods above with window between "no smoking" and "fasten seat belt" signs. The window is the seat behind, replacing conventional signs.



# ONLY **TWA** OFFERS



## SIESTA SLEEPER SEATS!



Seat in upright position allows you to dine, or catch up on your work.

Seat half reclined—legend extended—is perfect for reading, or just resting.

Seat in full recline provides almost out comfort for rest or sleep.

Available at no extra cost on all **TWA-JETSTREAM** flights in the U.S.

Here's the most luxurious service coast to coast...and only TWA offers it! Giant TWA Siesta Sleeper Seats at regular First Class fare aboard the magnificent TWA JETSTREAM. You're far back for sleep...with six feet to stretch out in. Or set up in spacious, lying-down comfort to enjoy superb Jetstream Ambassadeur service. Cocktails and hours of converser Superb meals cooked to your order in flight, served with freshly brewed coffee, unspiced liquors! For reservations, call your travel agent or contact TWA office today.

(Illustration for service seats shown exclusively by TWA)



# Los Angeles Jet Operating Plan Detailed

Los Angeles—Details as to just how jet transports will be handled when they begin operating from International Airport here were outlined last week by representatives of American Airlines, which will introduce Boeing 707 service to Los Angeles at the start of the year, the Civil Aeronautics Administration and airport management.

Donald K. Pearson, chief of the Air Traffic Control Planning Branch for Region IV, described the traffic procedures and new facilities that will be part of jet operations.

Inbound jets will have three holding patterns at 20,000 ft. in view of turbine fuel consumption problems when holding time becomes significant. From the holding patterns, they will be fed into the regular IFR approach patterns with standard procedures. Routes for arrival and departure, Pearson said, at first, mean constant patterns, the airport's acceptance rate is 36 arrivals per hour, while, at jet penetration from high altitude use used, acceptance falls to 24 arrivals per hour.

Holding patterns will be one and two minute types and will be located to avoid inbound traffic from the east and north. One area will be located 15 nautical miles north of the Palmdale Ores, 56 nautical miles from Los Angeles, at the intersection of 303 IAWC radial of Palmdale and 075 radial of the Santa Barbara Ores, on a standard pattern holding to the north on Victor 107 runway.

Another area will be at the Edgemont intersection, 16 nautical miles east of the Ontario Ores, 45 nautical miles from Los Angeles, at the crossing of 075 radial of Ontario and 315 radial of Ontario Ores, a standard pattern to the east on Victor 16 runway. The third area will be at the Fontana entry sector, 16 nautical miles northeast of the Ontario Ores and 45 nautical miles from Los Angeles, formed by the crossing of 121 radial of the Palmdale Ores and 012 radial of the Ontario Ores, a standard pattern holding to northeast along Victor 5 runway.

Using a CAA Marine B-57, a flight check of these areas and procedures will be conducted last week.

New equipment needed for jet handling includes a long-range radar which is still being installed and will be operational about July 1. Additionally, a radar display that can be used in unaided check conditions is scheduled for installation.

Standard equipment already operational includes precision approach radar, expert surveillance radar, ILS and sequence landing lights for approach lights in the instrument runway, 2RL

Complementary equipment to the terminal area at it is the planning stage and includes a terminal VOR near the east end of the airport, use of runway visual range, a preflight communication system feeding into Los Angeles air route traffic control center from the area which will enable direct pilot-controller communication. Additionally, long-range radar plans for which runway operational ranges of 150 to 200 nm are to be placed at locations such as Paso Robles, Las Vegas, Needles and Phoenix.

Another aid to jet flight will be installation of weather teletype equipment for more transcontinental routes which will be capable of from 600 to 1,800 words per minute transmission, Pearson said.

Using this, New York, neither will be available for flight plans in Los Angeles within 18 min of the observation. Track lines operating at stations open for further use at the time will disseminate the data to stations on the same line.

Other aspects Pearson noted were use of strip edge departure technique by which track data will be fed to a scanner. In this the pilot will inform the tower of his expected departure time and clearance will be initiated. As the plane is bunched up just prior to engine starts, final clearance will be obtained with automated use of, on-gate will be started and time and instant notified.

Departure from Los Angeles will involve the jet's high climb rates. Following takeoff to 30,000 ft., climb will be maintained in a "thick atmosphere" (an oceanic point), after which a steepening track will be followed using a climbing turn until the altitude is back over Los Angeles at a higher altitude. For north-southbound flights, climb tracks will keep aircraft over the ocean for the early climb stages, with south and southeast bound aircraft in a rising lead over near Long Beach in Oceanic, north-bound, over Grand.

Speaking for American Airlines, P. J. Mellins, the western region's operations officer, pointed out that American is conducting a jet transport study at the rate of one jet leading finger which will be capable of handling two jets at one time.

Present construction is built around plans to tie the plane in after landing, until the passenger, service the aircraft and depart. Departures will have the airplane loaded, the ramp edge clearance obtained, then two engines started to taxiway power, after which heavy thrust motion will push the

plane backwards out to taxiway where the other two engines can be started and taxi initiated.

Cost of the facilities includes a fixed 125 kw power source, plus meter service for the plane. Ground start order will furnish air for starting the first two engines third and fourth will be started at first taxi.

At the airplane program to save power, ground power will be direct acted, but a 12.5 kw generator on a trailer will handle power for the airplane lights and communications between aircraft and tower until the plane's two other engines are started.

Refueling will be by pressure system from truck trucks, using a system known as "Primary system" for using Laramie to tank. Kerosene is not used while J-1 is used two tanks per gallon on an average fuel. Los Angeles will be the 707's low maintenance base, Mellins said, although major overhauls will be done at Tulsa.

For the passengers, American has ordered preloading baggage bins for all its turbine transports which will expedite loading and unloading baggage from planes. Inside the terminal, where American has completed some expansion and has more under way, additional check-in positions have been added to almost double capacity in order to handle the larger passenger loads.

## Dutch Tu-104 Critics Attacked by Soviets

Moscow—Russian aviation critics are charging Soviet aviation officials with supporting attacks against Aeroflot's Tu-104 from non-Australian service in the Dutch ports and performance.

Secondarily, Australia, official publication of the Red Air Force, has also claimed Dutch "imperialism" in suggesting that the USSR agreed to the air route primarily to strengthen its strategic military aims and further complete the "great" term, despite "Tupolev one hardly be distinguished from an atomic bomber."

The Soviet military paper criticized an official Dutch Air Force opinion which recently pointed out a "circle" of "at least, thousands of kilometers" in which the Dutch air alleged to have pointed to the possibility of an atomic attack on the Netherlands by Soviet planes designed to Tu-104. In addition, the Russian critic said, "Dutch service of Palmdale, where they controlled the article in a book for now demands that the Netherlands re-examine jet programs on Aeroflot's Tu-104 service to Australia."



# Plan Sought to Avert Used-Plane Surplus

By Ford Estess

**Washington**—Prospects of flooding the end-plane market with hundreds of piston-engine aircraft, now being ordered on used-airplane surplus by air and helicopter markets, in performing military, aircraft, and government efforts into a search for ways to avert a possible economic disaster within the industry.

Service and studies are now being conducted by a number of groups in an attempt to find an answer, or combination of answers, to prevent an estimated 1,000 to 3,000 piston engine aircraft throughout the world from being placed on sale in a used-plane market already nearing the saturation point. This estimated figure includes military transports, U. S. and foreign, which may be declared surplus within the next few years.

Although aircraft have not placed heavy reliance upon sale of surplus planes to help finance air equipment, the industry feels that part of the risk recovery to support its aircraft programs (AW Oct. 7, p. 25), even before many of them have taken delivery of their first turbine aircraft.

In addition to the loss of new jet equipment—more than four times that of piston planes—there also is the need for new ground equipment and facilities, which is often more costly than the jets themselves, partly increasing the reliance need for risk to cover their construction.

As a result, airline companies predict that failure to dispose of piston aircraft at prices at least equal to book value will cause a contraction in sales and replacement plane which, in turn,

could have repercussions on the national economy as a whole.

Airlines agree that there is no single and simple solution to the disposal problem and that efforts will have to be expended along several different lines and that, even then, some government assistance probably will be needed. To keep prices of used-planes stabilized, the following steps have been suggested to industry spokesmen:

• **Piston engine aircraft must be made available for sale gradually**, keeping the supply and demand roughly equal.

• **New foreign markets for used aircraft** must be found and financial encouragement given potential buyers in foreign markets.

• **Airlines must make every effort** to keep piston engine aircraft operating even after they have been replaced by jets or turbine service, thereby reducing the supply of used equipment on the market. The equipment could be utilized for passenger charters, air-tugs, gliders or for the carriage of low priority mail and parcel post and cargo.

Another suggestion that has been offered by some sources, and one that is strongly opposed by Congress and government officials, is that the military buy all surplus equipment from the airlines at a fixed price and place the planes in stockpiles for an emergency. This, air supporters contend, would give airlines a good price for the aircraft sold, at the same time, remove the equipment from any possible competition which might result if it is sold to foreign lands or domestic suppliers. Second, surplus and surplus aircraft could be sold to the military in the event of an emergency. One to the government would be dragging, however.

At present, the most serious effort is being made to develop a market for aircraft in foreign countries. According to one independent source, there are still undeveloped areas of the world that can be opened by the formation of new airlines.

Such policies, which do not create cash, and the latest turbine-powered aircraft but would demand types not obsolete or becoming obsolete in the U. S. These new lines could find their way into the world-wide network of major international airlines which are now having new production U. S. airlines or the latest foreign types thereby possibly expanding the market for new aircraft to the larger countries.

These new airlines, or extensions of existing ones, the sources reported, also would create a further market for surplus ground equipment, overhaul shops and other items the piston engine aircraft that are becoming obsolete in the jet age.

It added, however, that many small foreign airlines, which have a definite need for used airplanes do not have ready cash with which to make full payment, although they generally have some cash plus a good credit rating. Therefore, the industry is taking advantage of this potential market, considerable financial assistance would be required.

Commercial banking firms at this time probably would be unable to handle the financing program required, since, but they have expressed a willingness to participate to the extent of \$1 to \$10 of the lease of the Export Import Bank or similar government agencies could make the loan.

The Export-Import Bank has extended millions of dollars in credit to

most exporters in the sale of new equipment but has not been found with the problem of extending credit to assist in the sale of used aircraft. It is now studying the situation and may soon be in a position to find a way.

Current demand for second-hand transports at all price levels appears to be the heaviest in South America, Central America and the Far East although there is a limited demand for used planes in most other areas. The strong demand for medium twin-engine transports, with the heavier four-engine planes further limited, but sales could be expanded providing the prospects of the potential buyers are boosted through liquidation in the financing of government equipment.

Supplemental air services also might become potential buyers of used piston engine planes, but their future prospects are less uncertain. One of the largest developments in the supplemental long-range planning of the aircraft industry is the long down-line jet transport. Air Canada has already decided by the CAB.

Another domestic market is the air plane dealer who sells his surplus inventory and convert the planes into executive aircraft, cargo planes or modify to fit the needs of new potential buyers throughout the world.

One leader, Frederick B. Allen & Associates of New York, already has contacted to buy 28 American Airlines Company (AA) for lease and make in the U. S. and abroad (AW Sept. 2, p. 41). Allen told Aviation Week that he feels there will be a good solid market for the used long-range transport such as the Douglas DC7, if it can be sold at the market when they become surplus. He added that if the aircraft could hold onto a good price at DC7, would the new jets and turboprops are fully integrated into operations and then released gradually, the market would be held up.

One method some airlines have employed in disposing of the large twin-jet planes is to trade them in to the manufacturer on new jets. However, as airline spokesmen said this is not the answer to the long-range problem because the manufacturer would usually offer the planes for sale rather than the price.

Regardless of the steps taken to create a stable market for used commercial aircraft, the market will be made gloomier if the aircraft surplus, which will have large numbers of piston engine transports for sale, dump them on the market all at once. Industry spokesmen say that only through close coordination between the military and commercial markets can the disposal of aircraft be carried out in orderly fashion.

## COCKPIT VIEWPOINT

By Capt. R. C. Robeson



### As Maine Goes

As Maine goes this winter the nation goes in the Arctic. No, not politics—winter visual landing. The Strategic Air Command, beginning this November, will conduct a test program at Dow AFB, Bangor, Me., to investigate the needs of narrow gauge runway lighting.

This is a continuation of the program begun last year at March Field, Calif., in which SAC made extensive studies of approach lighting. The Dow field experiment will advance that of weather with a catch feature. In addition to Cat III approach lights, the Dow installation will utilize 1,000 ft. of narrow gauge runway lighting.

### Vexing Problem

The visual and program is extended, of course, to provide SAC with some answers to the chronic vexing problem of all-weather landings although other military commands and the Aeronautics Administration Board as well as various interested government and civil agencies will be invited to cooperate.

It is expected that the program will provide information and recommendations to the operational needs of the complete visual system (Cat III approach lights plus narrow gauge runway lighting) under actual snow weather conditions.

With new cooperation from State of Maine weather first should indeed be a severe test. (This refers both to take part in some of this testing.)

In addition to light questions, SAC wants to study the ground operations and maintenance difficulties encountered in this installation. Specifically it wants answers to such things as operation during snow and ice preparation conditions; problems of removal of ice and snow, the possibility of aircraft damage caused by striking lighting equipment; adverse aircraft snow loads at various passageways, etc., due to installation of lights in snow-covered areas. (These lights are spaced 100 ft. longitudinally along the runway, the two "bars" of lights being 30 ft. on either side of the runway centerline, that is, a 90 ft. gap.)

### Navigational Radio System

The instrument approaches a complete navigational radio and system will be used. Procedures will be made for test instrumentation, including photographs, to substantiate the results and provide a filmed record of the landing aid equipment. As in the March Field evaluation, this new test will utilize a large number of pilots in order to get maximum from a broad experience base. Using all available types of aircraft operated by pilots.

There is no reason to believe that the Dow experiment will be one which has been, or less elaborate as conditions, than the masterpiece at March which proved military and civil authorities to adapt the Cat III approach lights at National Stratford. For more than a decade a small group of pilots had fought for this important safety item, at times securing flight support from the Civil Aeronautics Administration, USAF, Navy, Bureau of Standards and elsewhere. But now after non-operational periods were allowed to make decisions regarding tests for pilots.

The approach light test being done at this place in Acadia, Maine, and Federal Airport, is not deliberately unimpaired by visibility, was at least highly limited. Heavy fog and snow could not have been served in the street roads. So we kept on being aircraft because of poor approach lights.

Now we are in need of equivalent runway lights. As pointed out here previously (AW Sept. 29, p. 31) there are those who would substitute the answer in the use of the approach lights. Fortunately organizations such as the Strategic Air Command do not seem easily won to their work systems in the name of expediency. With SAC's latest thoroughness, and its trust from Maine weather, we can now have some real information on a complete visual system for degradable all-weather landings.



### Peking Institute Designs, Builds Light Transport

Two light light transport designed and built by technicians and students of the Peking Aeronautical Institute has been successfully test flown (AW Oct. 15, p. 12). Aircraft seats eight passengers and is suitable for STOL operations on short grass airfields. Flight: Max gross weight is approximately 655 lb, maximum speed is approximately 130 mph, and maximum altitude is about 15,710 ft.



## WESTERN'S THRU CHAMPAGNE FLIGHTS®



## THE WONDERFUL WAY TO MEXICO CITY

Schedule, service!

Welcome to your reserved seat on a flight en route to Mexico City—Western's unsurpassable Champagne Flight. You're off to a wonderful trip!

Here's your detailed plan of private club champagne. Be our guest for a luxurious, full course dinner—complete from appetizer to gusty exit—while you relax

in real Mexican atmosphere. *Mojave!*

Western's Champagne Flight overflies Old World drama and New World luxury for the first hours in the sky today. And you can enjoy through-out-earlier service from all the West!

It's a real "Isleto Flight"—on Western Airlines, the wonderful way to Mexico City!

Western's Champagne Flights are nonstop from Los Angeles—with thru connections from all the West. Call Western Airlines.



©"Champagne Flight"—a service originated by and trademark owned exclusively by Western Airlines

► **Lockheed Aircraft Service Inc.**, reports that it sold more than 180 of its flight recorder units during the first six months of its sales effort. Eight commercial carriers have placed orders for the equipment; accidents in aircraft considered to be above 25,000 ft., each receiver and strongly lease conditions of flight over long operating periods.

► **Makani Airlines'** overtly flight head quarters control was scheduled to be switched from Ulm and Milan, N. Y., to Chicago Center Airport last week. Makani's executive offices, which also have been moved from Ulm to the airline's new maintenance and head quarters building at the airport, is scheduled to reopen for business today. The new headquarters features 133,000 sq. ft. of floor space and a full corridor-lined reinforced concrete roof which Makani claims to be the largest of its type in the world. The building will house up to 14 Carrier type aircraft and one accommodate the largest airlines in service today.

► **South-Texas International Airport** reports 132,496 national and foreign passengers used its facilities during September, to bring the total to 1,807,991 passengers during the first nine months of 1955. A total of 1,377,099 lb. of cargo, and 14,400,000 mail items, were handled at the September, 1955 with air freight and air express paying 13% and 2% respectively.

► **Trans World Airlines** plans to use the new Lockheed 1049 Constellation aircraft on all transatlantic and intercontinental passenger flights this winter. By Dec. 15, TWA will equip all these flights with the 1049 except one Super-G Constellation flight service to be used on the New York-Boston to London-Vladivostok route on Sundays, returning Thursdays. TWA also will begin new rate national flights early next 1049H service line operation No. 6 on its New York-Shanghai-Panama and Rome-Milan-Cairo-Panama-Cairo-New York route.

► **United Air Lines** is now operating its flights into Alaska Gates and Yampa-town, Ohio, enroute to Douglas DC-6 or DC-68 service. Four daily services are being operated into the New York area with two daily flights going into Chicago and Cleveland. United also is beginning new nonstop first-class line route service between Oakland and Los Angeles. On Oct. 25, the airline begins morning or coach service between Boston and Cleveland, using Douglas DC-7 equipment.

► **Pennair** has a wingtip of British European Airways with British Overseas Airlines Corp. is growing in Britain, although most observers feel that strong opposition to such a proposal from BEA Chairman Lord Douglas and BOAC Chairman Sir Gerald D'Almeida will kill the plan. However, high operating and maintenance costs of BOAC, estimated at twice the costs of other carriers of similar size, has caused the airline to look abroad and could force the issue.

► **Lockheed Aircraft** decision to demonstrate its turbojet Electra in Europe and Asia may pay off with new sales. At least three foreign flag carriers are withholding demands for new equipment until they see the Electra operate on their own grounds and under their own maintenance environments. Biggest roadblocks to American sales campaign comes in the high cost of new aircraft and difficulty in obtaining financial backing.

► **Plots of most European carriers** are discussing a third crew member on all routes. However, they contend that their stand differs from that of the Air Lines Pilot Assn. since they want that the third crewmate remain on flight engineer status at a pay scale not to exceed 80% of a captain's pay. Because of these demands, Air France is forced to appoint the Viscount with three crew members in the cockpit.

► **U.S. aircraft manufacturers** are being outbid by European airlines for their small representation at the September technical conference of the International Air Transport Assn. in Cannes, France. For example, one U.S. engine manufacturer was represented by its London subsidiary. As a consequence, British manufacturers dominated the conference in discussion of turboprop and turbojet problems. The U.S. aviation industry, in contrast, was well represented.

► **International Air Transport Assn.** traffic conferences have been conducted entirely in the English language for the past three years, but delegates from foreign flag carriers probably will cause a session of simultaneous translation of proceedings into at least two languages. Three delegates are then elected primarily to the issue of discussing technicalities in a language other than their own and are concerned over the possibility of misinterpretation or the chance of getting tripped up by semantic capriciousness.

► **Wish for Moscow**, Egypt's nationally owned airline, to buy three Russian Tu-104 jet transports despite the fact that the aircraft seats three on the former's preference list. European financial backers are afraid would like to buy Gerdard is actually asked to its route and would accept de Havilland Comets as second choice. However, the French and English firms would accept payments in hard money. Russia will accept Egyptian currency. As a result, Egypt probably will buy the Tu-104s even though the airline considers the price "very, very high" and still knows very little about the plane's operating costs. Moscow will open routes to Frankfurt next year, but not about week-end flights with England for a route to London but still has been unable to settle on terms for a bilateral pact with France.

► **Air India International** is campaigning to reduce customs and immigration at its ports in India as a means of encouraging tourist travel. Spokesmen for the carrier maintain that most Asian countries continue to burden tourists with detailed paperwork before granting entry privileges but see India's desire to relax entry requirements is also shared with such countries as Pakistan, Burma, Thailand and the Philippines.

► **Midair** East Airlines is developing new traffic by placing emphasis upon a regional type operation within the Middle East and Europe. The carrier feels there is a profitable and untapped traffic market immediately available by offering a feeder service within the two areas to connecting highland passengers.

► **International airlines** are adapting for a future that would record and broadcast flight weather reports from transpans flying over areas where reports reporting stations are scarce.





**WILGOOSE TURBINE-ENGINE TEST FACILITY**—(top picture). Here tomorrow's power plants are "born" under conditions of simulated altitude, speed, and temperature often impossible to attain in actual flight. It is the most complete privately-owned turbine-engine test facility in the world.

**FLORIDA RESEARCH AND DEVELOPMENT CENTER**, a completely air-conditioned plant with 17 acres under roof, is specially equipped for development of new propulsion systems of almost any type. This facility supplements Pratt & Whitney Aircraft's research and development installations in Connecticut.

## PROVING A PAIR OF THOROUGHbred JETS

Whether the 30,000-pound thrust class J-58 . . . or the small, highly efficient JT12, aviation people know these two great power plants by Pratt & Whitney Aircraft as thoroughbreds.

Aviation people know, as well, that these new members of the "first family" of aircraft engines will be thoroughly proved in performance before ever taking to the air.

Beginning with matured design, and backed by unparalleled experience, Pratt & Whitney engines are tested and re-tested, developed and refined in facilities

second to none. Principal among them are the Willgoose Turbine-Engine Test Facility, heart of Pratt & Whitney's complex of research and development installations in Connecticut, and the new Florida Research and Development Center. The Florida center is specially equipped to develop and test advanced propulsion systems, and here the J-58 first roared into life.

Both thoroughbreds, Pratt & Whitney Aircraft's new J-58 and JT12 engines before long will take their place in dependable power plants for new generations of American aircraft.



**J-58 JET ENGINE**, the most powerful yet built by Pratt & Whitney Aircraft, is shown on a test stand in Florida. It is designed for operation at very high Mach numbers.



**JT12 JET ENGINE**, the smallest built by Pratt & Whitney Aircraft, produces 2000 pounds of thrust for a total weight of only 400 lbs. With a single spool and fixed geometry, the JT12 promises outstanding performance, reliability and ease of maintenance for many possible applications.



### Pratt & Whitney Aircraft

Division of United Aircraft Corporation, East Hartford, Connecticut

**CONNECTICUT OPERATIONS**—East Hartford, North Haven, Southington, Meriden, Middletown  
**FLORIDA RESEARCH AND DEVELOPMENT CENTER**, United Florida





## Why **LABIL** is a powerful link in the communications chain

Speed and reliability make Lant, Stromberg-Carlson's new data link, ideal for automatic transmission of flight information from light aircraft to ground receiving and control locations.

Into the line the pilot or observer can enter 13 types of data regarding flight and target. When the ground control group wants the information, a lamp on the panel of the airborne equipment lights. The pilot or observer presses the transmit key, and the entire stored message is automatically transmitted over his existing voice communication equipment.

Greatly increased reliability is achieved by transmitting each character twice.

All the receiving end the message is checked for errors

due to noise interference. The error detector examines the two transmissions for complete agreement. Thus, prints the message out on a teletypewriter. Speed of transmission is limited only by the bandwidth of the communication equipment and protocol device.

The standard format and digital nature of each transmission make Lant easily adaptable to long-range operational control systems in which automatic data handling is a requirement.

Complete technical data on Stromberg-Carlson's Light Aircraft Sessy Information Link is available on request.

*"There is nothing finer than a Stromberg-Carlson"*

**STROMBERG-CARLSON**

A DIVISION OF GENERAL DYNAMICS CORPORATION  
1401 N. GOSMAN ST. • ROCHESTER, N.Y. 14609  
Electric and communication products for more than 60 years



## SPACE TECHNOLOGY

### Navy Unveils Low Cost Sounding Rocket

By Craig Lewis

El Paso-Nue, low-cost meteorology and sounding rocket called ARCAS was unveiled at the First National Conference on High Atmosphere conducted here at Texas Western College by the El Paso Branch of the American Meteorological Society in conjunction with the New Mexico-West Texas section of the American Rocket Society.

Details of the ARCAS rocket were unveiled at a session which included discussion of both rocket and balloons techniques for sounding conditions in the upper atmosphere, along with discussions of current research and experiments in that area.

Designed specifically as a low-cost meteorological sounding rocket, ARCAS is a solid propellant vehicle being developed by Aerobics Research Corp. The program is sponsored by Office of Naval Research with the support of the

Branch of Aeronautics and Air Force Cambridge Research Center, according to Lt. Cmdr W. S. Houston of Office of Naval Research. ARCAS is expected to help study the need for a flexible, low-cost unit for use in atmospheric research programs at universities and colleges, he said.

To meet ONR requirements, Aerobics Research has produced an eight-stage solid rocket which is 8 ft in diameter, 78.5 in. long and weighs 71 lb. ARCAS provides 250 cu. in. of space to handle a payload of 12 lb. including parachute and nose cone and has a maximum altitude from sea level of 260,000 ft.

In flight, the ARCAS motor burns out after 26 sec. when the rocket is at 40,000 ft. and maximum velocity is 1,500 fps. ARCAS then coasts to peak altitude, which it reaches about 100 sec. after launch. Maximum acceleration is about 10G.

ARCAS is fired from a standard launch bracket which weighs 99 lb. and can be assembled by two men within two hours. Launches take and free vehicle to a horizontal position for landing and it can be fired within a 30 deg. vertical cone for firing. To meet a 100 ft. per sec. velocity requirement, a follow-on stage is placed around the rocket vehicle to serve as a gas seal.

Separation system has a 75 sec. delay between burnout and separation. When ARCAS reaches altitude, a pre-programmed chute opens the nose cone away from the spent rocket motor at a relative velocity of 10 fps. A 30 ft. launch connector to the nose cone pulls apart from the parachute container and allows the parachute to deploy.

There is very little experience with parachutes at 260,000 ft., according to Houston, but estimates indicate that a 26 ft. diameter D-5 and Mylar in-



### Space Station Would Orbit at 22,300 MI.

Five-man space station conceived by Research Division of North American Aviation, would be 15 ft. long and 7 ft. diameter. It would require a launching booster vehicle weighing about 5 million lb. and would orbit at an altitude of 22,300 mi., Rochester, which is developing a solid-propellant boost engine (AW Aug. 15, p. 10) and the space station could be used for astronomy, solar and ionosphere studies or as communications relay station, navigation and remote sensing station. Ash radiation shielding weight normal for as much as 20,000 40,000 lb. of vehicle and weight of 61,000 lb., according to Rochester officials.







## anti-jamming techniques pierce the shield of countermeasures

Figure 1. *Staphylococcus aureus* strains isolated from patients with MRSA.

GENERAL  ELECTRIC

A DEPARTMENT IN THE DEFENSE ELECTRONICS DIVISION

AVIATION WEEK, November 2, 1958



500 YEARS E. WOODS RD  
 SHERRYVILLE, ILLINOIS  
 Serial complete (working location status on)  
 PARADOX - model T-3885-30  
 NAME \_\_\_\_\_  
 FIRM \_\_\_\_\_  
 COMPANY \_\_\_\_\_  
 STREET \_\_\_\_\_  
 CITY \_\_\_\_\_

## HOUGH

THE FRANK E. GEHRKE CO.  
1000 N. 10TH ST.  
MINNEAPOLIS, MN 55403



# Space Cooling System Demands Reliability

By Richard Simeon

Los Angeles—A cooling system for manned and unmanned versions of an orbital vehicle, now described to the Society of Automotive Engineers by Joe S. Tupper, Hamilton Standard Division of United Aircraft Corp.

Vehicle dealt with two use with a mission time up to 4 hr, with about 1/2 hr spent out of atmosphere. Vehicle would be divided into a manned compartment and one or two unmanned equipment compartments. The system included environmental vehicle servicing to about orbital speed, orbiting the earth several times in unpowered flight, then re-entering into the atmosphere, reestablishing a controlled landing. Criteria were:

- Specified performance must be met at all conditions
- Reliability a prime consideration in choosing system, low redundancy, low weight and other factors
- System weight must be the minimum consistent with the two foregoing criteria
- Ground handling must be simple and flexible
- Initial testing and maintenance costs must be kept to a minimum.

Assuming the vehicle would spend all but a small portion of flight time out of atmosphere, a stored refrigerant was called for, with water as a prime candidate, with additional means of meeting performance of situations where boiling temperatures of water at ambient altitudes presents a too high, i.e., transient, problem.

Operation would be in a weightless condition as well as in high acceleration. Design included means to ensure liquid containment to keep the vehicle level transfer also satisfied with coolant, and nondetrimental phase transfer through the refrigeration cycle during its use, to make provision for emergency accident loss as well.

Stored coolant was preferred over mechanical refrigeration since rotating machinery is minimized, although larger bulk coolant storage is a penalty. The coolant system is also simple, even to the extent of having a backup control system for the stored refrigerant at little additional weight penalty in view of the mission is suitable.

System was evolved called for a refrigerant storage system separate from the operating portion of the system with controls appropriate to maintaining refrigerant loss.

Tupper noted that use of a separate or integral storage system and control system would greatly depend on the application at hand, and that what would be justified for one would not necessarily hold for another. For the particular case effort vehicle, however, the proposed separate storage was judged adequate to meet reliability standards plus providing the performance level required for the comparison with short-term flight.

Vehicle equipment compartments would be pressurized to nitrogen, which also could be the pressurizing agent for a separate independent storage type system.

Assuming water as a pressure fluid, with all vehicles of flight Tupper said an ammonia or similar refrigerant cooling system might be economically used to cool guidance equipment at low altitudes, or water alone at all altitudes with a heat exchanger and water reservoir in the supplementary cooling system.

## Aircraft Escape Systems

A track of aircraft escape systems was described by Arnold J. Brack and George Hildebrand of Republic Aviation Corp.

Tomco's aircraft escape systems must be capable of safe, effective performance at ground level at altitudes in excess of 100,000 ft., and from subsonic to supersonic speeds.

It was pointed out that before a choice can be made between an open cockpit and an escape capsule system, more knowledge and data concerning human capabilities must be secured.

Much can be said and heard about the advances being made in diving, flying, landing and parachuting, but it has become obvious that only by developing toward the common performance of the most advanced aircraft can escape system designs avoid obsolescence.

The design of tomorrow's escape system must produce a system capable of safe, effective performance in a range of requirements which staggers the imagination.

- Ejection immediately following crash landing or water water.
- Escape from aircraft on the ground at standstill or in motion.
- Low level flight patterns, below 1,000 ft.
- Escape from altitudes between 2,000 and 45,000 ft.
- Escape from altitudes between 45,000 and 100,000 ft.
- Escape from altitudes in excess of 100,000 ft.
- Escape at subsonic and supersonic speeds.

Newest concepts of escape capsule



## NASA Proposes Inflatable Satellite Applications

Inflatable satellites, made of thin plastic covered with aluminum foil, have been proposed for space technology tests by scientists of National Aeronautics and Space Administration. Deflated satellite is ejected into orbit from a rocket carrier, is automatically inflated by a nitrogen gas cylinder. Gas is allowed to escape after inflation to prevent the satellite from becoming pressurized to the point it is fractured by a micro-meteorite. Inflatable satellites (1) as a sphere, proposed to disintegrate up to 100 ft., which would be a good result in solar light for sighting. Inflatable solar target (2) is shaped to fit a solar collector. Large solar energy collector (3) could be used with space vehicles to observe power plants on Earth. Parabolic reflector (4) could be used as a space communication antenna.

COLLINS SYSTEMS ARE NOW IN PRODUCTION FOR (LEFT TO RIGHT): THE NAVY'S BLACKWELL, FOR A ONE-CHANCE VIGILANT, FOR 3 PROTECTORS AND NINTH, ANTI-SUB, A-1, A-10, A-11, A-12, A-13, A-14, A-15, A-16, A-17, A-18, A-19, A-20, A-21, A-22, A-23, A-24, A-25, A-26, A-27, A-28, A-29, A-30, A-31, A-32, A-33, A-34, A-35, A-36, A-37, A-38, A-39, A-40, A-41, A-42, A-43, A-44, A-45, A-46, A-47, A-48, A-49, A-50, A-51, A-52, A-53, A-54, A-55, A-56, A-57, A-58, A-59, A-60, A-61, A-62, A-63, A-64, A-65, A-66, A-67, A-68, A-69, A-70, A-71, A-72, A-73, A-74, A-75, A-76, A-77, A-78, A-79, A-80, A-81, A-82, A-83, A-84, A-85, A-86, A-87, A-88, A-89, A-90, A-91, A-92, A-93, A-94, A-95, A-96, A-97, A-98, A-99, A-100.



why America's  
newest jets  
use **COLLINS**  
**ELECTRONICS**



These supersonic aircraft require ultra-dependable electronics systems, highly speed and low communication, navigation and radar identification. Such systems must be integrated, adaptable to the varying airborne requirements of today's newest jets.

Collins integrated electronics systems achieve building-block flexibility through modular design of all basic units. Designed into each aircraft, a space-saving Collins system retains the economy of standardized production and simplified maintenance.

These specialized electronics packages are an important part of Collins' contribution toward greater defense per dollar.

COLLINS ELECTRONICS COMPANY • DEAN RAPIDS, IOWA • DALLAS, TEXAS • BURBANK, CALIFORNIA



The Marquardt logo is written in a stylized, cursive script font.

# ADVANCED POWER SYSTEMS FOR AIR AND SPACE



Projects meeting the ever increasing needs of Advanced Power Systems for Air and Space operations are currently under way at Marquardt. Here, as an example, is a list of projects that stimulates creative hypotheses. Marquardt engineers and scientists are engaged in the following diversified areas:

#### ADVANCED PROPULSION CYCLES

- Engines for cruise propulsion for hypersonic missiles and piloted aircraft and an accelerating device for Space Vehicles
- Electrostatic Propulsion—Plasma Jet, Ion Propulsion and Magnetohydrodynamics
- Nuclear Reactor

In addition, current applications projects include spaceborne rocket power for Bureau, Space Bureau, X-7 (first vehicle), Q-4, and Kingfisher.

#### EXOTIC FUELS

- Evaluation—Energy, Compatibility and Logistics

#### CONTROLS & ACCESSORIES

- Wet Gas Servo Systems
- Auxiliary power for Space applications
- Variable geometry Inlet Controls

#### TO ENGINEERS AND SCIENTISTS

Engineers capable of contributing to advances in the state-of-the-art and scientists who desire to do proof-of-the-principle research in the fields of propulsion systems, automatic controls, advanced test facilities and high temperature materials may find, here at Marquardt, the climate best suited to your interests and talents. May I suggest that you contact me?

Ray E. Marquardt  
President

The Marquardt Aircraft Co. logo features the company name in a stylized script font, with "AIRCRAFT CO." in a smaller, sans-serif font below it. To the left of the name is a small graphic of a stylized aircraft or wing.

VAR HVS AIR POMONA-CALIFORNIA OGDEN UTAH



# SPERRY INTRODUCES...

## New portable radar safety meter for survey of microwave power fields

Like many technical developments, the high-power microwave systems now coming into wide military use present an unexpected problem: Medical and military leaders are increasingly concerned with the safety of personnel working with these "super radars" which produce tremendous microwave energy fields in their transmitters and antennas.

Current information indicates the same methods for measuring safe working environments near powerful microwave devices involve safety measurements of microwave power density in the area. But, until now, application of this principle has been restricted because engineers have lacked suitable portable equipment for

making these measurements.

As a leading producer of advanced radar systems, Sperry has devoted extensive research to the problem of ensuring safety in their operations. Result of this investigation is the new Microwave Power Density Meter. Weighing only 6 pounds, the meter provides a simple but highly accurate method of measuring the existence of concentrated energy as "hot spots" close by high power microwave stations, transmitter tubes and plasmaoids. It is completely portable and contains its own power supply.

Utilizing the recently accepted safe energy level of 10 mw/cm<sup>2</sup>, the Sperry meter quickly requires the operator

point directly above or below the susceptible level. The meter is used by "stud a meter." A single knob operates the meter, permitting use by non-technical personnel.

If you'd like more information about the new Sperry Microwave Power Density Meter, write for Literature #18-444-0000.

SPERRY

SPERRY MICROWAVE ELECTRONIC COMPANY, CLEARWATER, FLORIDA - DIVISION OF SPERRY RAND CORPORATION  
Admission also required in California: Permit to Survey Equipment (PSE) in New York: "Classified" New Orleans: QSA Approval. See Publisher: See Site



**GENERAL SPECIFICATIONS**

Sperry *Model 644*  
644 Power Density Meter

FREQUENCY RANGE: 2700-3300 mc  
5300-5800 mc  
8000-9600 mc

DETECTABLE POWER DENSITY:  
1 mw/cm<sup>2</sup> in 30 mV/cm cm

POWER: 8-watt mercury battery

designs, according to Beck had 150-160-180, even as it increases its own frequency" at what amounts to an on-board system. The effect on aircraft gross weight has been reduced considerably. While the correct weight, in shading concept of the superoxide system and its gross to about 500 lb, the equivalent weight of the capsule is still about 150 lb.

- **Insulation within antenna output system envelope.**
- **Portable weight drop/mile.**
- **Compassively low output output (three separate modes).**
- **Reduced vulnerability to aircraft fire or battle damage.**

A comparative analysis between the two sets and capsule can be made with regard to similar design concepts such as system architecture and configuration where the capsule requires considerable larger separation forces and in the case of large size capsules the threat requirements are become critically high. Studies done on capsules are similar to both sets and capsule. The capsule, being completely enclosed, has the advantage of better configuration and control of power control than perhaps simplifying substructure requirements.

### Inherent Stability

Bluff (see, Man's) shaped capsules tend to offer certain advantages of aerodynamic stability, minimizing need for stabilization devices, perhaps avoiding the need entirely.

They also are subject to higher deceleration forces, but the short duration only. Designed to not exceed human tolerances in deceleration, these sets of wing and duration will provide capabilities for a low level high speed response.

High deceleration forces have reduced deceleration levels which act as a much longer time period. This can be an offsetting factor.

Enclosed set type capsule may be used for emergency use down from high altitude due to power loss in cockpit, and the shielded capsule provides excellent protection from air resistance for the occupant during free fall from altitude.

Capsule provides greater protection against adverse temperature due to capsule bluff shapes which have low heat transfer characteristics. The capsule provides a protective environment when enclosed within the aircraft upon fall out of the cockpit ejection system at high speeds.

At low altitude, high or low speeds, escape capsule low altitude capabilities are compensated by layered complexity and complex time lag function.

For landing and post landing conditions, the capsule must shield the pilot

against ground impacts up to 600, and must incorporate a suitable emergency landing system as well as automatically deployed flotation gear for water landing. Low-power capsule systems must be provided, the pilot for escape from capsule after touchdown. Airlift escape capsules can be required. The capsule can offer a degree of protection shelter in extreme situations and circumstances.

Principal advantage of the enclosed capsule escape system is that secondary personnel are available to the pilot in event of primary loss or ejection system system failure.

This makes possible the so-called "dive down concept" of aircraft operations. It must be remembered, however, that pilot cockpit not self-ejecting, these secondary systems are not ready to utilize as the primary/next man ejection.

The secondary system must still meet generally with the primary system once they are a portion of a larger and more complex system. The pilot's personal equipment also does and handles which are part of the enclosed capsule system may often require serious restrictions to mobility and access within the cockpit.

It must be pointed out also that the capsule is more susceptible to battle damage of a type that can be survived by the autonomous man than such as escape system for an escape system according to Beck and Thibault.

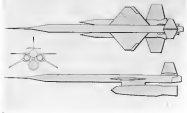
Fundamental considerations in selection and design of escape capsules were

discussed by Donald M. Root of Northrup Aircraft, Inc., who took the view that escape systems should be designed for operations in the areas where the large majority of escapes are made, rather than at the level of a high performance overall operating at its maximum dynamic pressure limit.

Root pointed out that statistical evidence indicates that if the escape system is designed for maximum dynamic pressure conditions of flight, relatively few lives may be saved in the areas where, very few, if any, escapes are made, while more lives will be jeopardized in the areas where more escapes are made.

Dealing on escape at low altitudes and speeds Root said the ground level capabilities of a system is enhanced if the man parachute is to be ejected upward, reducing total weight is required of the capsule ejection rocket which maximum height required to effect parachute opening at low speed is a determining factor.

The agreed consideration of a really simple escape device which would be sufficient for escapes at dynamic pressures approximating 2,334 psf and Mach 1.2 and at very low speeds and altitudes as well. Root acknowledged that very careful considerations must be given to such design parameters as ejection tracks, operating sequences, testing and maintenance of all factors in obtaining the highest order of reliability and operating capabilities consistent with the speed and altitude spectra where statistics show the greatest number of escapes are attempted.



### Lockheed Q-5 has Rhombic Wings

However, details of Army Lockheed Q-5 program report show the rhombic wings as opposed to delta's ignored wings of such unusual as its predecessor, the A-10. The Q-5 is a subsonic aircraft and theoretical limit, and has a parachute for recovery. The design's wing layout is described by Northrup Aircraft Co.



Start with  
a hole ...



instead of  
a headache



## Start with TIMKEN® seamless tubing and save steel, machining time

**B**ORING out bar stock to make hollow parts is a waste of steel and valuable machining time. Besides, it's a headache. The remedy is Timken® seamless steel tubing with the hole already there. You pay only for the steel you use. On top of that saving, you cut machining costs. By eliminating that unnecessary boring operation you free part of your screw machines for other jobs—add machining capacity without adding machines.

And you can actually get a better quality finished product with Timken seamless steel tubing. The reason is the way we make it. A solid round is forged over a

mandrel, thoroughly working the metal inside and out. It's the rotary peeling operation that gives Timken seamless steel tubing its fine forged quality and uniform rigid grain flow for extra strength. Carefully controlled temperature and peeling speed keep this quality uniform from tube to tube, heat to heat, bar to bar.

We can help you increase your steel savings by having our engineers recommend the most economical tube size for your hollow parts job. They'll give you a size guaranteed to close up to your finished dimensions. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable "TIMROSCO".

# TIMKEN Fine Alloy STEEL

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS STEEL TUBING



BUDIAN dog (left) is subjected to vision test. Dogs are placed in rocket cages (right) after completion of laboratory tests.



## Soviets Recover Research Rocket Dogs

Washington—Russian scientists have fired two dogs to an altitude of 275,000 ft in a single stage research rocket carrying a payload that weighed 5,778.45 lb—greater than the weight of Sputnik III—according to Soviet sources transmitted here. The dogs were recovered safely and are in good condition, the report said. This was the second launching of such a rocket.

The weight figure includes "total weight of the payload: scientific apparatus, radio transmitting device, power sources, the biometric cabin with the experimental animals and auxiliary systems, together with the instrument section," the Soviet newspaper Izvestia said.

The felt-lined cabin contained "a regeneration system, a self-contained system for recording the biological functions of the animals and a special motion picture camera" with a speed of 24 frames per sec., holding 300 meters of film for 11-12 min. of photographs. Dogs were secured in special cages "ensuring individual clothing."

Izvestia showed details of the 180-sec. flight with details of other flights to 66,15 and 431,74 mi. and discussed a "globular stratified space suit made of

Plingon with a detachable helmet and an oxygen feed system." It said the "vacuum space suit guarantees the necessary conditions for the life of the animals" in non-hermetic rocket cabins fired to 66 mi.

Dogs used on the 180-mi. flight had been trained for several months. They

were named Belinka and Perpetua. Dogs for the shorter flights have weighed from about 11 lb to approximately 17½ lb.

Landings occurred Aug. 27 from "the cradle" landings of Soviet Eastern territory," Izvestia said. No rain had been made of the results of the



SOCCOLOGRAPH records respiration rate, blood pressure after dog's second rocket flight.



## AERO-THERMODYNAMICISTS EXPLORE HIGH-SPEED RE-ENTRY

*A report to Engineers  
and Scientists from  
Lockheed Missile Systems—  
where expanding missile  
programs assure more  
promising careers*

Advanced weapon system technology has brought to the forefront problems areas requiring solutions in interaction between aerodynamic and thermodynamic phenomena. Typical of these is the problem of high-speed atmospheric re-entry. Expanding research and development activities have coincided with acceleration in top priority programs like our Polaris ICBM. At the same time, positions for qualified engineers and scientists have opened up that are unequalled in accessibility or in opportunities for moving ahead.

Positions in aero-thermodynamics include such a cross in aerodynamic characteristics of missiles in high Mach numbers, missile and weapon system design analysis, boundary layer and heat transfer analysis in hypersonic flow fields, and calculation of transient structural and equipment temperatures resulting from aerodynamic heating and radiation.

In addition, openings exist at all levels in Gas Dynamics, Structures, Propulsion, Test Planning and Analysis, Test Operations, Information Processing, Electronics, and Systems Integration. For those and other programs, qualified engineers and scientists are needed in our Research and Development Staff.

Dept. 1715, 962 W. El Camino Real, Sunnyvale, California

### Lockheed MISSILE SYSTEMS DIVISION

BURNING, FOLD ALTO, SAN RITO, SANTA CRUZ, VANDERBILT AFB, CALIFORNIA  
CAPE CANAVERAL, FLORIDA • ALBUQUERQUE, NEW MEXICO

Marvin Tucker, Aero-Thermodynamics Department Manager, right  
shows research area thermodynamic re-entry body parts being  
examined in Division's new "bullet" wind tunnel. Other staff  
Dr. Jerome L. Fox, Research Department Manager, Thermodynamics, left  
and Robert L. Nelson, Assistant Department Manager, Aerodynamics.



SPACE and probes dug in rocket flight.

rather launching of the large size stage rocket, or if it cannot avoid.

The rocket was fired at a small angle to the vertical in a fixed direction. The rocket was stabilized "during the entire flight, including the vertical part of its flight." To ensure the success of the test, the rocket was fired from the experimental. Cuts loaded in a selected area, the rocket was.

Rocket control instruments for measuring:

- Concentration of the electron. In-vacuum was an ultra-thin wire dispersion radio telegrapher.
- Ion composition of the atmosphere.
- Concentration of positive ions.



### Polaris Second Stage

Polaris first ballistic missile second stage ignited successfully during test at Cape Canaveral, Fla., and was destroyed after only a few hundred feet above the launch pad (AWE Oct. 20, p. 28).

- Electron temperature.
- Air pressure. Instruments were tested for and magnetic measurements.
- Microscopic measurements.
- Ultraviolet region of the solar spectrum.

• Improved resolution of the earth and the earth's atmosphere. The instrument was not described.

Letters released to recent publication from the Russian Information Group physical test coverage of preliminary results of rocket and satellite re-entry tests.

Rockets sailed in flights up to 112 mi. altitudes on ascending speed of 1-65 mi. per sec. and a descending speed

of 108 mi. per sec., according to the GGY report. Nose cone is separated from the body of the rocket at the top of the injection and a trailing parachute is opened at an altitude of about 35 mi. At just above a mile, the main parachute system goes into operation. Nose cone lands in 500 to 600 sec., and the period of descent, with fins open, lasts for 500 to 700 sec.

The report said the parachute system had worked without failure in all landings. It also said, with regard to the space tests designed for "near flights" that "all the calculations and designs of Soviet scientists and design men have paid off."



**EXTREME  
TEMPERATURES  
AND  
PRESSURES  
CALL FOR  
AWICA  
"B" SEALS**



**WITH EXCLUSIVE  
DOUBLE-SEALING FEATURE**

Specifications: Successfully tested for 1500 psi at 1500 degrees F on small sizes. Standard sizes from 1/2" to 12" — special diameters to your requirements.

AWICA — for use in aircraft and missile systems and in industrial fields in a compact, lightweight, low-cost joint.

Send us your tube joint sealing problems.

AWICA "B" Seal, with exclusive double-sealing lip, means no design. Double contact is made as joint is completed to assure a positive seal that is self-maintaining, even under extreme conditions.

Additional advantages are:

- Easy assembly of entire joint
- Positive indexing, and prevents automaticity
- Repeated contact and disassembly in use, damage and
- Action for joining dissimilar materials

Clamping methods are designed for a low torque value to prevent shearing of bolt. Patented "back-bolt" device provides maximum holding strength and simplifies installation in restricted areas.

AWICA Clamps,  
couplings and straps  
manufactured by



12121 MONTAGUE ST., PASCANA, CALIF.

**TURBO PRODUCTS INC.**



**RYAN**  
IS EXPANDING  
IN ELECTRONICS  
IN SAN DIEGO

**RYAN**  
IS HIRING  
ELECTRONIC  
ENGINEERS  
TO EXECUTE  
NEW LONG-TERM  
CONTRACTS FOR  
NAVIGATION  
AND GUIDANCE  
SYSTEMS

Get in on the ground  
floor now with  
America's pioneer in  
C-W Doppler Radar

#### ELECTRONIC ENGINEERS

for environmental test  
components and mate-  
rial evaluation and reli-  
ability analysis

#### DESIGN ENGINEERS

for microwave antenna  
development, computer  
design and evaluation  
and testing computer  
development

#### FIELD ENGINEERS

capable of handling engi-  
neering problems in the  
field

#### SYSTEMS ENGINEERS

to integrate analog and  
digital navigation and  
guidance systems

#### PRODUCT AND PACKAGING ENGINEERS

to develop designs, layout  
and production of elec-  
tronic systems into com-  
plete portable packages

We're looking for  
**JOHN JACKSON**  
for details

**RYAN**  
AERONAUTICAL  
COMPANY

DEPT. 44  
2701 HARBOR DRIVE  
SAN DIEGO 12, CALIF.



**How an electronic engineer from St. Louis  
found a better job and a better life  
in cool, clean, clear-sky San Diego**

It was the last day of our wonderful vacation in San Diego two summers ago. We were sitting on the terrace at the house of a couple we'd known pretty well back in Missouri, looking out over the bay.

"It must be wonderful to live here," said my wife. She sounded doubtful.

"That it is," agreed our host, and his wife chimed in with "When can we expect you?" "We've just about decided to come out when I retire," I told them.

"When you retire?" insisted Tim. "Why wait all that time? Make the move now!"

"That's a little distant about a job," I retorted. "I'm doing pretty well where I am."

"Maybe you can have your cake and eat it too," said Tim. "San Diego's got a tremendous growth industry. Growing fast in electronics too. Lots of opportunities. Why don't you check a few companies tomorrow morning before you start back. Really especially,

I hear they're going like a house afire!"

So I did—and the people at Ryan had a place for me. It carried more responsibility than my old job—and it gave me a chance to change into a brand-new phase of electronics. I guess I hadn't realized that I'd been getting into a rut—that I was ready for a logical assignment.

That's how it all began. Coming to Ryan was the simplest decision I ever made. I'm getting a real sense of personal satisfaction out of the advanced work we're doing as continuous-wave radar. The company has recognized my progress, too—in a tangible way.

Meanwhile, my wife and I had had for the first time we really living. We love our new house—the kids can play outdoors every day of the year—we're close to the beaches and the bay and just a short drive from the mountains or the desert.

San Diego's a metropolitan city. Lots of interesting people who've come here from all over the U.S. Fine stores and restaurants and theaters. Excellent schools, including a four-year state college and a new branch of the University of California.

But the topper is our climate. Never hot, never cold, always delightful. So far so I'm concerned, those Midwest summers and winters are just history.

Any electronic engineer who knows that the ability and experience have fitted him for a bigger job ought to talk to Ryan. We're growing faster than ever—and we need men who are going with us. We now have many full-fledged career jobs waiting to be filled.



HEADQUARTERS in our new headquarters with many other being built here from investment in San Diego.

## AVIONICS



GROUNDING AIR communication for 1,200 sq. miles VHF frequencies normally limited to line-of-sight range have been achieved by a FST using meteorburst technique. Tests were conducted by Stanford Research Institute under USAF sponsorship.

## Meteor-Burst Avionics Resists Jamming

By Philip J. Klein

Washington—Radioic immunity of meteor burst communications is making promising and direction finding, plus its ability to transmit voice, telemetry and forecasts at VHF frequencies over distances greater than 1,000 mi. with extremely low power makes new techniques extremely attractive for military use, it was reported here during the National Symposium on Extratropical Range and Space Communications.

With meteor burst technique, the message is stored in ionospheric gaps, transmitted at a greatly amplified rate during frequent brief intervals when a meteor trail exists to serve as reflecting surface (AW June 17 1970, p. 36).

New developments in meteor burst as well as tropospheric and ionospheric scatter communications reported during the symposium included:

- Meteor-burst technique demonstrated operating over 600 mi. path in Canada now exhibits an error rate which is "comparable to an ultra radio relay type," G. W. L. Dorn of Permittivity, Portland Electric Ltd. reported.
- Canadian "Buck" system, operating at the frequency of 40 mc with 100 watts radiated power is experiencing error rates of 0.1% at one broadcast less than 1% at the other where there is multiple retransmission, Dorn reported.
- Weathered electronic pictures have been successfully transmitted over a

900-mi. path using meteor-burst technique, using bandwidths up to 100 Le, C. S. Wulfsberg of Radio Corporation of America told the symposium.

Stanford Research Institute's William R. Vincent asserted.

• Meteor burst communications might possibly be used to complement existing long-range communications to increase the reliability of high-frequency radio, extend the range of tropospheric scatter or increase the capacity of ionospheric scatter, second



FST-44 type aircraft is equipped with Vigil antenna for meteorburst technique.







## GE's Operation "Check-Up"



From General Electric Flight-Test Center at Edwards AFB, flight test and engineering services for aircraft maintenance, instrumentation, data reduction, operations control, quality control, advanced design, etc. Plans shown

include the Flight Region II Missile, North American F-105, Boeing B-70, Lockheed F-104, Convair F-106, Douglas XF-105, and the McDonnell F-103

## ...at EDWARDS AFB!

As flight test centers like this, General Electric technical and engineering services quickly gather and interpret experimental flight data to guide design toward peak performance for the engine-airplane combination.

Operation "Check-Up" enables the men at General Electric's Jet Engine Dept. to design, develop and improve jet engines like the J47, the J48, and the new J49—engines which write history.

Headlines like "Speed Record Added to Fests of F-104"—"GJ-805 to Power Convair's New Jetliner"—"Starfighter Sets New Altitude Mark"—"New Air Force Bomber, F-105 Will Shoot for Mach 3"—confirm the sky-country of GE jet power—the mastery established by J47-powered Sabrejet over Korea.

*Progress Is Our Most Important Product*

**GENERAL ELECTRIC**  
JET ENGINE DEPARTMENT CINCINNATI 15, OHIO

## GE's Operation "PIONEERING"

### ...at the JET ENGINE DEPT. in CINCINNATI

In the Cincinnati suburb of Evendale, a team of professionals in propulsion is involved in the design, development and demonstration of advanced aircraft propulsion systems. This is truly "Pioneering Propulsion"—and the men who pioneered the world's fastest aircraft never join to join them!

If you like to meet and solve new problems... if you like the challenge of the unknown... if you're the kind of man who likes to help write tomorrow's textbooks in today's test lab... if you don't know that "it can't be done that way"...

**you'll like it at GE... where ability is recognized and rewarded.**

Due to expanding activities and military and commercial jet engine demands, we need more design engineers to help shape tomorrow's work. One unique use of small-unit task groups emphasizes and encourages creative freedom. One engineering staff has more than doubled since 1955, and annually about 30% of our engineers have been promoted to more responsible positions. Career potentials for degree engineers with U. S. citizenship are open to many. Skills—

**RELIABILITY... AERODYNAMIC DESIGN... ELECTRICAL CONTROL DESIGN... ADVANCED ENGINE PERFORMANCE ANALYSIS... ENGINE RUN-IN TEST... CONTROL COMPONENT DESIGN... TEST INSTRUMENTATION... ENGINE TEST CELL DESIGN... DESIGN HOBBIESTS... DATA REDUCTION SYSTEM... and many others.**

Send your resume—or, for more information, write or phone:

**Mark Division, General Electric Co.  
Jet Engine Dept. AW-1103  
Cincinnati 15, Ohio  
Phone POPlar 1-1100**

Collect long distance calls; a bill is accepted any weekday 9 A.M.-4 P.M.

**GENERAL ELECTRIC**

C. Frots of Jenks & Bader, Inc. (unaffiliated paper with Research)

Whether repeated test runs to date on a 900-hp motor have led, however, Long Beach, Ill., and Akron, Ohio, N. Y., indicate that good fuel-side pictures can be transmitted with 30 kw. power at 40 mc. Multipath delays have not been a limitation, he added.

BECA is using a 1,550 ft. line from the antenna, with 18 db. gain over a half-wave dipole, giving a 6 db. beamwidth. Transmitted carrier is modulated with three levels of frequency shift. Service, not corresponding to what, are corresponding to black and the third for a horizontal transmission path. Some improvement in quality, says, is possible through use of a continuous frequency response. It could have accurate standards at each terminal, Welches said. (Paper was co-authored by W. H. Blum and R. J. Wagner, Jr., also of BECA.)

Schmitt's paper centers on repeat performance and comments on both initial installation and subsequent adjusting rates of ionospheric scatter systems can be achieved through use of automatic control. (AEG, NAEF's Blum, reported.)

The AEG technique, which enables an ionospheric scatter system to operate through periods of low signal-to-noise ratio when it might otherwise be forced to shut down, employs a special second order control of the standard feedback code for each telephony character. Code is to designate that each character

has an identical 3.4 m/sec/square ratio, Blum said.

As each character is received over the ionospheric scatter circuit, it is noted to see if this 3.4 m/sec/square ratio is present or. If not, an indication of transmission cross-the-spectrum does not point out the character, but rather sets a repetition signal to help the system waiting status to repeat the character.

In this manner, a high proportion of packet errors are noted but there is a consequent reduction in average information rate. Blum pointed out, and also adverse propagation conditions. For signal to noise ratio above 15 db, there is negligible loss down due to use of AEG and with S/N ratios above 121 db, there are practically no packet errors. Below this value, however, it was found to rise sharply as S/N ratio drops off.

Multipath propagation between two telephony stations using beam coded characters can produce a multipath error in its information error rate. Since the difference in delay time between the different paths becomes appreciable compared with the duration of a bit length. Commonly used four-channel multiplex systems employed in some telephony scatter circuits have a bit length of 6.7 milliseconds; thus a second affected by differences in path delay of more than about three milliseconds. Helms, Rouse Electronics, told the symposium. Multipath delays of as much as 10 milliseconds are occasionally encountered in ionospheric scatter circuits.

Technique for preventing increase in error rates with multipath propagation is, in his conclusion, during the frequency of the transmitter and receiver following transmission of each bit was described by Helms and Rouse of Page Communications Engineers Inc. Using this only multipath frequency, receiver is not response to the signal element propagated by the shortest path and rejects the longer path signals.

Installation of such equipment reduced delays resulting from multipath propagation errors from a peak of 25% of total time to a maximum of 25% Rouse reported.

Another new development in ionospheric scatter systems is a simple "pilot beam" concept, which, according to Helms, can be operated simultaneously at two different frequencies, R. C. Kral, of National Bureau of Standards reported. Analysis was designed by Page Communications.

Kral predicted that meteor-burst systems will move faster to application ionospheric scatter than to replace it.

During a question-and-answer ses-



### Midget DME-T Station

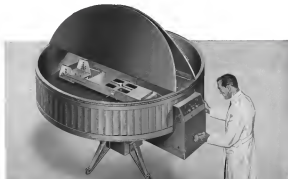
Small, low-cost DME-T distance measuring equipment, serially by National Tele Phone & Telegraph Co. at recent Vortex Symposium in Indianapolis (AW Oct. 15, p. 46), can be added to existing VOR stations or DME instrument approach facilities. Small DME-T station, originally developed for possible use in Navy submarines, is expected to sell for less than \$20,000 in production quantities of 700.







with 10 times greater accuracy,  
larger centrifugal capacities,  
maximum flexibility...and  
*priced lower than any other  
centrifuges now available!*



This new design concept also results in manufacturing economies which are reflected in the rest of the machine. The new machine has the lowest priced cast-iron finger now available—in spite of their greater strength, flexibility and rigidity. Ask your Gardner representative for complete information today.

Model no.	Dimensions	Net Weight (kg)	Capacity (people)	Seat Max. (kg)	Q. Mount (mm)	Wind Speed (km/h)
SA-1001	80" width 50" height 50" depth	10.000	100	100	100 (2x)	20" width
SA-1002	80" width 50" height 50" depth	10.000	100	100	100 (2x)	20" width
SA-1003	80" width 50" height 50" depth	10.000	100	100	100 (2x)	20" width

**Large custom assemblies:** Features and dependencies include the large assemblies and installation of large custom tool modules. We will post report.

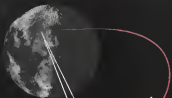


1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 2680, 26



Available accessories include additional slip ring, serial output, microphone input, high pressure air and hydraulic systems, TV mapping systems. Any accessory can be added at any time by the user. The mounting base is standard equipment.





# SAFE FLIGHT SAFE LAUNCHING

HIGHLY RELIABLE

High-reliability missile systems require a launch rail that is rugged, accurate, reliable, and safe. Right on request, Cannon's experts offer a full quality and design experience can help. With the right launch rail and most reliable launch rail available.

Through proper care, analysis, and control, our Cannon organization can launch missile quality to any AGI demand.

Cannon Missile Connections have been designed to meet the specialized demands of the guided missile program. They are made in a number of basic shell designs built for heavy duty service, with a variety of different materials available as inserts. More than 22 different post arrangements accommodate from 8 to 140 contacts. Coaxial, thermocouple or high-temperature contacts are available.

For complete information write for Bulletin on Guided Missile Connections or contact our factory engineers for assistance in solving your particular problem.

## Missile System Connections For Safety in Flight

Thousands upon thousands of Cannon "standard line" connections are being used today in missiles of all types. They are rated for the quality and the safety they can hold. In each and every one. More than 27,000 different sizes to meet just every need. For a full brochure coverage, write for the New Cannon Plug Guide, Bulletin CPG-3.

## CANNON PLUGS

Cannon Electric Company, 2880 Skyway Blvd., Suite 210, California, Berkeley, CA 94705. Cannon Electric Company, 2880 Skyway Blvd., Suite 210, California, Berkeley, CA 94705. Cannon Electric Company, 2880 Skyway Blvd., Suite 210, California, Berkeley, CA 94705.

units are spaced longitudinally along the track, at the edge of the control deck. Height of the shield glass above the air end of the flight deck can be increased for low approach by using the forward Lens Aid unit or decreased for steeper climb by using the aft one.

A continuous range of cockpit height vision can be provided by making variations of a degree or less to the standard four degree center approach glide slope on one unit or another with a Base Angle Selector control.

Approach angle reflexion which the three units provide overlap to some extent. If one unit fails, the aircraft type still outdoors use it can be given a reference to a visible glide path by one of the other units with an appropriately adjusted to the Base Angle Selector.

Each Lens Landing Aid unit consists of three vertical rows of five rectangular mirror plates. Frontal lenses placed edge-to-edge. The Frontal is subdivided into consists of a series of cylindrical lens segments approximating to steps or corrugations on one face of the isotropic mirror plate.

Each lens segment has the property of reflecting light into an angle below the incident ray. The lens is a lamp to transmit the necessary light through the lens.

As the pilot moves from one beam of light to the next, there is an apparent movement of the reflexion light across the face of the lens and the light source behind the other lenses are visible once their output is directed away from the pilot's eye.

Intensity of the light sources must

be carefully matched to background light intensity by a brightness selector switch.

If intensity is too high the light beam spreads, causing the reflexion spot to appear to the pilot as a large diffuse glow which is not as noticeable of error in the approach path as the small clear cut light beam.

Temperature of the lenses must be held constant. If too, because too cool, thermal contraction causes the lenses to distort and apparent toward of the reflexion but from one lens to the next between center and edge. To prevent this, a thermostatically controlled hot air blower holds lens temperature constant at 110°F.

Two main lamps based on a gaseous stable element comprise the Lens Landing Aid unit for ship motion. Each unit has two lamps in a long, narrow plate to hold the glide slope steady on the selected angle. All main lamps within the unit are in a lateral plane to hold five reflexion light bar and obtain light horizontal and parallel. If the angle between reflexion bar and detector bar is not allowed to vary in response to ship roll, the problem of compensation would be made difficult or impossible for the pilot.

The Lens Aid control panel contains a switch indicator to show whether or not the units are responding to signals from the stable platform and the Base Angle Selector.

The Lens Landing Aid system is supplied with 60 cps, 75-watt, 115-volt power for lights and drive and 480 cps, 25 amp, 15-volt power for the electronic drive circuitry.



## First Sidewinder Production Photo

First Sidewinder (AW Oct. 6, p. 21) production photo shows first clerk being made of guidance and control units at Pikes Corp. Government and Industrial Division, Pikes.

## VIBRATION TESTING

Today's rugged testing programs require new equipment with wider operating ranges...



New facilities permit us to offer vibration testing through the range of 5-1000 cps with (lowest) limits to 1000 lbs. under combined environments of +300 G's +300 F and vibration (up to 1000 G's). With special provisions, tests can be conducted to 1000 F. All test facilities, used as directed by the Bureau of Standards.

## INLAND TESTING LABORATORIES

1000 S. WILSON AVENUE, CHICAGO, ILL. 60607. CHICAGO, ILL. 60607. CHICAGO, ILL. 60607.



## Simplifies design-procurement!

It's the key to a wide range of pre-designed filler caps and components. Parts adaptable to aircraft, missile, aerospace and other activity fueling systems. Many combinations direct from stock. Write for your guide today!

## SPECO

Special Products Engineering Co., Division of BERRY AEROSPACE COMPANY, SPRINGFIELD, MASS.





**AUTOMATIC** landing system developed by the Royal Landing Experimental Unit of the Royal Aircraft Establishment is depicted above. Numbers indicate: 1—Automatic approach (track) using ILS beacon and compass for aircraft control, barometric height for descent; 2—Automatic approach (guide) using ILS beacon for aircraft, ILS glide path for descent; 3—Automatic lead (leader cable) using leader cable for aircraft, lead attitude for descent; 4—Automatic lead (slave) using leader cable for aircraft, radio altimeter for descent; 5—Automatic lead (locking of drift) using compass for aircraft, radio altimeter for descent; 6—Manual ground run using leader cable compass for aircraft control.

## British Test Automatic Landing System

By John Twestall

**London**—Automatic blind landing equipment is likely to become a standard installation in Britain's V bombers within the next 15 months, according to controls team Royal Establishment's Royal Landing Experimental Unit.

Automatic approach and flareout, at a minimum, have already been specified by British Overseas Airways Corp. and British European Airways for the Vickers VC 10 and de Havilland DH 121 jet aircraft. Full automatic landing facilities could be completed later.

British interest was triggered by leader cables for strength guidance, and down height information from a radio compass. Initial approach guidance is obtained from standard ILS beacon and

glide path installations. An automatic speed control coupling controls the throttle automatically to maintain a constant power approach speed and closes the throttle during flareout to landing setting. During the last five seconds, the system automatically locks off.

Blind Landing Experimental Unit was formed in 1945 at Farnborough Flight School, from specialists groups working at Telecommunications Research Establishment, Malvern and the Royal Aircraft Establishment, Farnborough. It moved to the new airport at Bedford last year.

British scientists admit there is little to choose between the landing performance of the British and the present United States system—the Bell radar

version (AW March 4, 1957, p. 32). Total weight of the additional equipment involved, which includes a control box, the leader cable receiver and aerial and the low level radio altimeter and aerial, does not exceed 100 lb. for a single-channel equipment.

Bedford scientists believe that the need for leader cables may prove only temporary as improved ILS systems known to be at an advanced design stage promise satisfactory automatic guidance to landings.

The most disadvantage of the leader cable is the need for 3,000 ft. under deck coverage when used in conjunction with aerial ILS installations. This distance is not generally available. One leading scientist says the later improved ILS equipment being used aboard down



**CONTROL** equipment for the British landing system is a built. Units are (1) to (3) pilot's cockpit flight control panel, automatic pilot including (3) to (4) turn indicator and (5) to (6) speed control unit and landing unit, pressure unit is (7) same as (6) as (8) is (9) Duddley equipment is (10) to (11) radio altimeter—leader cable receiver, leader cable controller gear unit.

*Stop burn through... eliminate craters!*

New P&H welders provide  
**exact heat,  
perfect timing  
for inert gas welding**

Built in high-frequency, gas, water, and spot-run controls enable you to weld materials as thin as .005 inches without burn through or crater! The new P&H welders give you P&H "Dial-lectric" control for fast access heat adjustment at the machine or by remote control. "Soft-star" device eliminates blasting — phase-shift and intensity shootback speed accelerating and stabilizer are instantly over each other range, eliminate chipping. And for inert gas welding at its best, you can have P&H zero balance built into your machine at extra cost. Write for bulletin "HF Welders," Dept. 317H, Harnischfeger Corp., Milwaukee 40, Wisconsin.



P&H AC-DC  
HF-WW WELDER SHOWN

3 Types—8 Models  
Change from metal-arc to inert gas welding with the flip of a switch

P&H AC High-Frequency WELDERS:  
4 sizes, 7 to 870 amps

P&H DC High-Frequency WELDERS:  
6 sizes, 3 to 850 amps

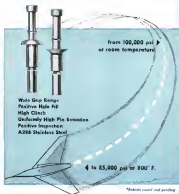
P&H AC-DC  
High-Frequency WELDERS:  
3 sizes, 6 to 870 amps



**P&H HARNISCHFEGER** WELDERS • ELECTRODES • POSITIONERS



## for Hi-Strength at Hi-Temperature the Cherry "600" Rivet\*



To meet the design requirements imposed by extremely high-speed aircraft and missiles, the Cherry Rivet research and development department has introduced the "600" A286

stainless steel blind rivet.

Data on the strength capabilities of the "600" rivet is available from Townsend Company, Cherry Rivet Division, P.O. Box 2157-N, Santa Ana, California.

### CHERRY RIVET DIVISION

SANTA ANA, CALIFORNIA

### Townsend Company

ESTABLISHED 1916 • NEW BRITGTON, PA.

In Canada: Permacore & Lullach Manufacturing Company, Limited, Oshawa, Ontario

to the strip, and the use of much shorter lead cables attached to flare-out and ground run.

Consistency, accuracy, smoothness of the British system, is one of a 35 ft. wind tunnel approach (inboard), imposed this writer who logged several hundred hours tracking on surface ILS and British Standard Beam Approach blind approach equipment.

During three touchdowns in the author's test of English Electric Canberra bomber aircraft, two were smooth and level, the Canberra showing only 1.6G. The third, coinciding with a gust, showed 2.4G and left a slight nose-whedown which is not uncommon.

The drift approach is to about four degrees, but touchdown on track was so snugly in case of the runway and in about the same longitudinal position that it automatically ended up during the last 5 ft. Approach speed to threshold was 129 ft. Outside after the aircraft was well established on ground run did the pilot intervene in the touch-and-go attempt.

Approach guidance to the intercept scope is controlled automatically at 300 ft. from the ILS receiver to the magnetic field generated by two leader cables. These are placed 178 ft. either side of the center runway line and carry with a 4 amp. current at 1,000 or 1,200 cps and 1,200 cps frequency respectively from a 31.5 kv. alternator. The magnetic field developed accurately defines the runway center and by using a small rotating loop to compare the two frequencies to a single receiver the aircraft is able to determine its position with respect to the runway center to within five feet.

Switch from the ILS glide path to the radio altimeter is made at a height of 190 ft. In this second phase the mean approach altitude is maintained down to a height of 60 ft. when flare-out and throttle closure commences.

Radio altimeter reads absolute height and rate of change of height extremely accurately, and a simple coupling into automatics to integrate serves to change the aircraft path or its height and rate of change of height as preprogrammed, the function (Phase 3) following an exponential path to touchdown. In the last automatic phase which is triggered at a height of 20 ft. and proceeds to touchdown by about five seconds (Phase 4), the drift is measured and acted by a computer rate application of rudder, back (about 10°) to the yaw is inhibited, and leader cable guidance, ignoring throttle closure during flare-out is automatic but after touchdown the landing gear is controlling under manual control with the assistance of the leader cable output and gyro compass.

A statistical analysis over 2,000

landings gave an average longitudinal center of 250 ft., lateral within 30 ft., heading errors 1 deg and a mean rate of descent at touchdown of 2 ft. No danger has ever been indicated on the development Canberra Victor Vulture or a Harrier Delta aircraft.

The Pave program landing system developed in a military system in conjunction with the Royal Landing Equipment Unit team at Bedford, is now utilized at a number of Royal Air Force air fields, and at Guters and Paderborn. It is now to be installed at Vickers and Bedford, and first Ministry of Civil Aviation audits was placed this month.

The military claim that it is accurate down to an altitude of 75 ft. and within 100 ft. of the final lighting system. Superiority of the installation over American ILS equipment derives from the use of a portable aerial system, according to Pave Technicians (note 1).

The smooth aerial system is in a rectangular shape, which allows setting up of the complex phasing system, and with auto-tilt-down system, and offers greater gain and stability. Being installed in an arc of plus and minus 70 deg from the center line inputs derived from the phasing system, and range as well as reducing beam distortion caused by reflections affecting echoes in the vicinity of the aerial.

Avoidance of beam interference by these reflections is one of the main factors behind the computer's close focus vision system.

All the major are fully stabilized by magnetic feedback from a new control. Electromagnetic isolation must on both transmitters to the extent that mechanical losses as well as increasing the reliability.

The location transmitter radiates two amplified, modulated signals at 90 cps and 150 cps in the VHF band (148.112 mcs) using two horizontal dipoles placed on opposite sides of the axis. Aerial uses the principle that a beam produced by a parabolic reflector can be deflected down the axis by a lateral movement of the feed. The carrier is modulated to a depth of 20% by rate of rise and the antenna receiver compares the difference with the depth of modulation. Output of the transmitter is 20 watts.

The gliderpath transmitter operates the same modulated frequencies in the VHF band with the beam directed vertically. The transmitter operates in the UHF band and high power output in the band of 12.15 watts has been achieved.

Recent modifications have replaced the computer with flat transistors which has led to reduced coupling between the upper and lower

stages, reduction in vertical polarization, reduction in back radiation from the lower aerial and an improvement in the vertical compression necessary to maintain a lateral glide slope of 3.5 altitudes.

The radio altimeter developed by Standard Telephones and Cables Ltd. is a conventional design. Its superior performance stems from customer detail modification. A F. Owen who led the development of the instrument said that the latest version was being installed for production in 1965. Improved and employs a ground reference step in place of a staircase. These two features cut the weight of the current version from 45 lb. to 25 lb.

The altimeter was developed by a 1,000 ft. low-level landing equipment. The altimeter landing equipment is an instrument with a range of only 100 ft. could be satisfactory. While this would not improve the accuracy, the circuit could be altered to make complex, which would lead to increased reliability.

#### Altimeter Sensitivity

Sensitivity of the altimeter is approximately 120 cycles per foot of altitude. All we have to do is "Omit" it, to measure this frequency within an accuracy of 246 cycles, which is not difficult.

The depth is calculated to read either 5,000 ft. or 600 ft. in one revolution. Absolute accuracy of the system is not too far. Zero down is set to match the correct height and height attitude and remains stable when set to within one foot.

Accuracy of the output in the auto-pilot circuit is that of the depth which can be read only to within 0.1 ft. Height signal output from the altimeter is converted in a coupling unit to an exponential face form.

Electronic altitude stabilization was developed by Mappin Radio Ltd. and was a parallel computerized receiver which, with its loop, 15 ft. The cables can be used in a single along the ground and the overall controlled smoothly.

A British SP2 autopilot and Standard Flight system instruments are used with little modification. The automatic throttle control was developed specially for the system by Smith which also makes the coupling unit.

Another coupling unit is responsible for taking off the drift which forms the last exponential phase of the lead. This is to be planned by the coupling unit, the aircraft heading with the top direction preset on the gyro compass and computes the most suitable rate and radius of roller correction. This correction has to be compatible with maximum deviation and reduced back conditions.

USAC TRANSPORT INC.

**WE COVER  
THE 43  
STATES**

◀

**AND WE'RE  
LOOKING FOR  
PRODUCTION  
RUNS**

◀

**DIRECT  
NATION-  
WIDE  
TRANSPORT  
SERVICE**

◀

**MISSILES  
AIRCRAFT  
ENGINES  
RADAR  
PARTS**

◀

**HONEYCOMB  
PANELING  
10' x 20'  
AND UP**

◀

**EQUIPMENT  
MODIFIED  
TO CARRY  
YOUR LOAD**

**457 WEST FORT ST.  
DETROIT 26, MICH.  
WO. 3-7913**



FIRST ON THE ATLANTIC...FIRST ON THE PACIFIC...

FIRST IN LATIN AMERICA...FIRST 'ROUND THE WORLD



The first Jet Clippers are Boeing 707s, the most thoroughly lightened aircraft ever to enter commercial service.

## PAN AM JET CLIPPERS-FASTEST TO EUROPE

Right now  
**FASTEST TO PARIS**

Starting Nov. 16  
**FASTEST TO LONDON**

The Pan Am Jet Clipper® is the fastest, largest and most powerful commercial jetliner in regular transatlantic service. Its inaugural flight marks an important first for America in the dawned age of international jet travel. Pioneering new equipment, new routes, new methods has been a Pan

American tradition for 31 years. Today the same faith in the future of aviation guides the company as in 1927, when a Pan Am Fokker F-7 flew the 90-mile route across the straits of Florida to Havana to become America's first "overseas" airline.

PHOTOGRAPH BY R. A. POLAK



**WORLD'S MOST  
EXPERIENCED AIRLINE**









Enlarged (left) brace model of the entrance gear at bottom of page shows full-size part worked and in operation. Pins are pins pins 50 ft. long which might be used as integral shaft and improve sections for strength as shown in illustration at right.



## Soviets Exhibit Models of Industrial Equipment

Models of some of the latest heavy logs, designs and extension projects in operation in the Soviet Union were shown in a recent industrial exhibition in Moscow. The Russians have confidence plans for the construction of heavy production equipment of these types. Included in the plans are 50 large power units to the World War II German Schlemmer, the largest of which could cost a total of about 10,000 metric tons. One of these power was able to form

all the parts for a J-35 jet engine in one motion. The U.S. and the Russians discarded several of these machines and took them out of Germany after the war. The Russians as well as U.S. production people consider such large power essential for the production of large, lightweight, high-strength parts needed in modern aircraft weapons. These large parts and power with integral rollers and spurs require a minimum of casting and afterwards, reducing

the assembled weight of a vehicle. The Civil Heavy Machine Building Plant (Uralmash) at Sverdlovsk, which apparently is Russia's largest machine plant, has been assigned the job of constructing most of the 12 heavy power units for its Soviet plant. It has been reported that models of at least one of these 10,000 metric ton power are now in operation at Moscow, Krasnodar, Tomsk, Kiev, Leningrad, Khabarovsk, Krasnodar, Voronezh, and Kharkov.



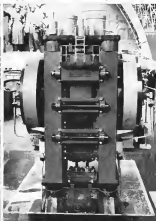
Large forging (left) produced by Russian power was exhibited in Moscow by the Soviet Ministry of Heavy Machine Building. The forging is especially the support structure for a helicopter engine in an aircraft. A display of Russian extension is shown at the right.



Large size of 12,000 metric ton extension power is evident from the solid guide rails which surround the model of the machine in the Moscow industrial exhibit. Front view is on the left, rear view is on the right. The pins are made at Sverdlovsk in the Ural.



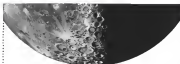
Very large model of a large power of 10,000 metric tons is shown at left. It was built by the Civil Heavy Machine Building Plant (Uralmash) at Sverdlovsk. The smaller large power (right) was made by the New-Krasnodar Heavy Machine Building Plant in the Ukraine.











## CONTROL ENGINEERS

(Electric • Servo • Valve)

### Move into Large Rocket Engineering and put yourself way ahead in your field

Help us to automate millions of horsepower designed into a great package—the High-Thrust Rocket Engine. Here are the facts.

The *Electrical System* includes Ground Support and Check-out Equipment which must be operable by military personnel. About the same, engine controls must be carefully isolated from other engine systems. Maintenance is more far, but never at the expense of reliability in accuracy of temperature, vibration and acceleration. You'll cover all aspects of electricity, deal with every branch of weapon systems.

Servo-mechanisms offer a broad spectrum—electronic, pneumatic, mechanical, hydraulic. Your analytical ability will be at a premium here, to evaluate methods of Missile Control, Thrust Control, and Pressure Control which must compensate for variations like changing mass, drag, separation, altitude, combustion efficiency, heat, shock, G, vibration etc. You'll be free of routine details, able to apply your training and experience toward a high level of professional growth.

Refers you to G\* deep and up, with very high pressures and flow rates, extremely rapid cycles, temperatures down to -300° F.

This is where the real advanced work in controls is being done from the breakthrough. Write, giving your background to: W. L. Jonston, Rocketdyne Engineering Personnel, 6633 Chicago Avenue, Canoga Park, California.

## ROCKETDYNE

A DIVISION OF W. P. INDUSTRIES, INC.

BUILDERS OF POWER FOR OUTER SPACE



shaft speed of 24,000 rpm, an inlet pressure of 50 psi, and a pump rate of 735 psi pumping 73F hydraulic oil. Input shaft speeds up to 24,000 rpm are reduced through a 3:1 gear set for continuous pump operation. Flexible-type mechanical shaft and separate pump cartridge from pre-lubricated gas seal. Unit incorporates a "zero-clearance" design, which, the master states, provides for a broad running and adjustment range—pressure and flow positive operating range. Design is said to provide favorable volumetric efficiencies while pumping low viscosity fluids.

Low-Ramjet Division, Lent, Inc., Elms, Ohio



### Missile Discharge Valves

Comprehensive check valve quick-disconnect unit is designed for cryogenic, controlled or uncontrolled flow. Flow rate is said to be up to 5,500 gpm of liquid oxygen at 70 psi with pressure drop of less than 4 psi.

Valve bore section can be used alone as a check valve. In certain applications, fluid flows in either direction and the check valve comes into play only after valve and nozzle sections have separated. Largest current size, 11 in. line size, is 14 in. long and weighs less than 50 lb. Other line sizes can be provided. Reaction Motor Division, Duval, N. J.

## WHAT'S NEW

### Reports Available

The following reports were sponsored by the Office Of Technical Services United States Department of Commerce, Washington 25, D. C. Application of Atomic Engines in Aviation (Procurement Memorandum Digests by A-100)—by G. N. Montezuma, A. E. Schell and Yu. N. Schell, and first published in 1957 by the Ministry of the Ministry of Defense of the USSR. Translated by Technical Documents Liaison Office, Wright Patterson Air Force Base 5330, (PB 131984).

Bacterial Activity in JP-4 Fuel—by S. Ruppman, Wright Air Develop-



### Wide Sheet Steel

High strength steel sheet, annealing 150 in. wide, will be in fabrication of solid perfect metal under design. One of the wide sheet will strengthen metal sheets by rolling through a cold water bath, "pickled" at Lukens Steel Co., is said to be the widest ever produced. Sheets now are 100 x 192 in., thickness varies from .002 to .010 in. Steel sheet will be developed at American Rocket Society meeting in New York City, Nov. 1973.

ment Center, U. S. Air Force March, 1958. 575, 20 pp., (PB 131613).

A Single Consolidated Chart of Oxidation Parameters for Gasoline Fuel—by R. C. Davis and B. V. Wolfson. Wright Air Development Center, U. S. Air Force, August, 1957. 550, 16 pp., (PB 131491).

Measurements of the Viscosity of Gas Mixtures—by W. A. Struss and R. E. Ekin. Ohio State University Research Foundation for Weight Air Development Center, USAF, August, 1957. 575, 21 pp., (PB 131575).

Development of an Improved Catalytic Inhibitor for Water Alcohol Solutions—by D. B. Cawley, R. C. Presnell and J. F. Goff. Wyandotte Chemical Corp. for Wright Air Development Center, U. S. Air Force, Jan., 1956. 525, 82 pp., (PB 131751).

Development of Improved Titanium Alloy for Application of Elevated Temperatures—by B. S. Larnett, Minn. engineering Laboratories, Inc., for Wright Air Development Center, U. S. Air Force, Mar. 1958. 5204, 53 pp., (PB 131749).

## Publications Received:

The Ships and Aircraft of the United States Fleet Seventh Edition—by James C. Fisher, Associate, United States Naval Institute, Pub. Ships and Aircraft, P. O. Box 140, Fife Church, Va. 22116, 44 pp.

Detailed information pertaining to U. S. vessels, active and reserve, building and ordered, also naval interests and guided missiles.

The Army Air Forces in World War II: Service Around the World Volume VIII—edited by W. F. Craven and J. L. Cole—Pub. University of Chicago Press, 5759 Elm Avenue, Chicago 37, Ill. 55 50 666 pp.

History of the American air strategy and operations during the war years. This seventh volume is the final volume dealing with service around the world. The other six deal with combat operations.

Looking at the Stars—by Michael W. Decker, Philosophical Library, Inc., 15 East 46th St., New York 16, N. Y. 6475 192 pp.

This well illustrated booklet is said to have had an interest in astronomy, since it starts with the story of astronomy and ends through the solar and stellar systems.

## STEEL FABRICATING COMPANY

AVAILABLE NOW

FOR LEASE, MERGER, OR SALE

This prominent Southern California Company has had no financial success since a merger in its past five years. It is now in a position to be sold or merged with a quality manufacturer of many types of products and equipment for its steady customers, and future.

If your product is made of steel, steel pipe, or other metals, do not fail to see these new companies opportunity to acquire a new steel company in plant facility.

One basic facility only, well-maintained plant, and good management and equipment good for your opportunities.

Write Mr. Robert W. Harris  
710 South Spring St.,  
Los Angeles, California



...not at

**Bendix-Pacific**

in Southern California!

We have important career positions open NOW at all levels in our small engineering groups. At Bendix-Pacific we encourage and provide the full use of your talents—plus even realize your potential in tomorrow's technology.

If you are qualified in any of these fields:

MISSILE GUIDANCE  
TELEMETRY  
INERTIAL RADAR  
MISSILE HYDRAULICS  
& MARINE HYDRAULICS  
SONAR

& ANTI-SUBMARINE WARFARE  
Please write to: B. Parker with qualifications or B. B. 101, 1011, 1012, 1013, 1014, 1015.

W. L. Parker, Engineering Manager, B. B. 101, 1011, 1012, 1013, 1014, 1015, 1016, 1017, 1018, 1019, 1020, 1021, 1022, 1023, 1024, 1025, 1026, 1027, 1028, 1029, 1030, 1031, 1032, 1033, 1034, 1035, 1036, 1037, 1038, 1039, 1040, 1041, 1042, 1043, 1044, 1045, 1046, 1047, 1048, 1049, 1050, 1051, 1052, 1053, 1054, 1055, 1056, 1057, 1058, 1059, 1060, 1061, 1062, 1063, 1064, 1065, 1066, 1067, 1068, 1069, 1070, 1071, 1072, 1073, 1074, 1075, 1076, 1077, 1078, 1079, 1080, 1081, 1082, 1083, 1084, 1085, 1086, 1087, 1088, 1089, 1090, 1091, 1092, 1093, 1094, 1095, 1096, 1097, 1098, 1099, 1100, 1101, 1102, 1103, 1104, 1105, 1106, 1107, 1108, 1109, 1110, 1111, 1112, 1113, 1114, 1115, 1116, 1117, 1118, 1119, 1120, 1121, 1122, 1123, 1124, 1125, 1126, 1127, 1128, 1129, 1130, 1131, 1132, 1133, 1134, 1135, 1136, 1137, 1138, 1139, 1140, 1141, 1142, 1143, 1144, 1145, 1146, 1147, 1148, 1149, 1150, 1151, 1152, 1153, 1154, 1155, 1156, 1157, 1158, 1159, 1160, 1161, 1162, 1163, 1164, 1165, 1166, 1167, 1168, 1169, 1170, 1171, 1172, 1173, 1174, 1175, 1176, 1177, 1178, 1179, 1180, 1181, 1182, 1183, 1184, 1185, 1186, 1187, 1188, 1189, 1190, 1191, 1192, 1193, 1194, 1195, 1196, 1197, 1198, 1199, 1200, 1201, 1202, 1203, 1204, 1205, 1206, 1207, 1208, 1209, 1210, 1211, 1212, 1213, 1214, 1215, 1216, 1217, 1218, 1219, 1220, 1221, 1222, 1223, 1224, 1225, 1226, 1227, 1228, 1229, 1230, 1231, 1232, 1233, 1234, 1235, 1236, 1237, 1238, 1239, 1240, 1241, 1242, 1243, 1244, 1245, 1246, 1247, 1248, 1249, 1250, 1251, 1252, 1253, 1254, 1255, 1256, 1257, 1258, 1259, 1260, 1261, 1262, 1263, 1264, 1265, 1266, 1267, 1268, 1269, 1270, 1271, 1272, 1273, 1274, 1275, 1276, 1277, 1278, 1279, 1280, 1281, 1282, 1283, 1284, 1285, 1286, 1287, 1288, 1289, 1290, 1291, 1292, 1293, 1294, 1295, 1296, 1297, 1298, 1299, 1300, 1301, 1302, 1303, 1304, 1305, 1306, 1307, 1308, 1309, 1310, 1311, 1312, 1313, 1314, 1315, 1316, 1317, 1318, 1319, 1320, 1321, 1322, 1323, 1324, 1325, 1326, 1327, 1328, 1329, 1330, 1331, 1332, 1333, 1334, 1335, 1336, 1337, 1338, 1339, 1340, 1341, 1342, 1343, 1344, 1345, 1346, 1347, 1348, 1349, 1350, 1351, 1352, 1353, 1354, 1355, 1356, 1357, 1358, 1359, 1360, 1361, 1362, 1363, 1364, 1365, 1366, 1367, 1368, 1369, 1370, 1371, 1372, 1373, 1374, 1375, 1376, 1377, 1378, 1379, 1380, 1381, 1382, 1383, 1384, 1385, 1386, 1387, 1388, 1389, 1390, 1391, 1392, 1393, 1394, 1395, 1396, 1397, 1398, 1399, 1400, 1401, 1402, 1403, 1404, 1405, 1406, 1407, 1408, 1409, 1410, 1411, 1412, 1413, 1414, 1415, 1416, 1417, 1418, 1419, 1420, 1421, 1422, 1423, 1424, 1425, 1426, 1427, 1428, 1429, 1430, 1431, 1432, 1433, 1434, 1435, 1436, 1437, 1438, 1439, 1440, 1441, 1442, 1443, 1444, 1445, 1446, 1447, 1448, 1449, 1450, 1451, 1452, 1453, 1454, 1455, 1456, 1457, 1458, 1459, 1460, 1461, 1462, 1463, 1464, 1465, 1466, 1467, 1468, 1469, 1470, 1471, 1472, 1473, 1474, 1475, 1476, 1477, 1478, 1479, 1480, 1481, 1482, 1483, 1484, 1485, 1486, 1487, 1488, 1489, 1490, 1491, 1492, 1493, 1494, 1495, 1496, 1497, 1498, 1499, 1500, 1501, 1502, 1503, 1504, 1505, 1506, 1507, 1508, 1509, 1510, 1511, 1512, 1513, 1514, 1515, 1516, 1517, 1518, 1519, 1520, 1521, 1522, 1523, 1524, 1525, 1526, 1527, 1528, 1529, 1530, 1531, 1532, 1533, 1534, 1535, 1536, 1537, 1538, 1539, 1540, 1541, 1542, 1543, 1544, 1545, 1546, 1547, 1548, 1549, 1550, 1551, 1552, 1553, 1554, 1555, 1556, 1557, 1558, 1559, 1560, 1561, 1562, 1563, 1564, 1565, 1566, 1567, 1568, 1569, 1570, 1571, 1572, 1573, 1574, 1575, 1576, 1577, 1578, 1579, 1580, 1581, 1582, 1583, 1584, 1585, 1586, 1587, 1588, 1589, 1590, 1591, 1592, 1593, 1594, 1595, 1596, 1597, 1598, 1599, 1600, 1601, 1602, 1603, 1604, 1605, 1606, 1607, 1608, 1609, 1610, 1611, 1612, 1613, 1614, 1615, 1616, 1617, 1618, 1619, 1620, 1621, 1622, 1623, 1624, 1625, 1626, 1627, 1628, 1629, 1630, 1631, 1632, 1633, 1634, 1635, 1636, 1637, 1638, 1639, 1640, 1641, 1642, 1643, 1644, 1645, 1646, 1647, 1648, 1649, 1650, 1651, 1652, 1653, 1654, 1655, 1656, 1657, 1658, 1659, 1660, 1661, 1662, 1663, 1664, 1665, 1666, 1667, 1668, 1669, 1670, 1671, 1672, 1673, 1674, 1675, 1676, 1677, 1678, 1679, 1680, 1681, 1682, 1683, 1684, 1685, 1686, 1687, 1688, 1689, 1690, 1691, 1692, 1693, 1694, 1695, 1696, 1697, 1698, 1699, 1700, 1701, 1702, 1703, 1704, 1705, 1706, 1707, 1708, 1709, 1710, 1711, 1712, 1713, 1714, 1715, 1716, 1717, 1718, 1719, 1720, 1721, 1722, 1723, 1724, 1725, 1726, 1727, 1728, 1729, 1730, 1731, 1732, 1733, 1734, 1735, 1736, 1737, 1738, 1739, 1740, 1741, 1742, 1743, 1744, 1745, 1746, 1747, 1748, 1749, 1750, 1751, 1752, 1753, 1754, 1755, 1756, 1757, 1758, 1759, 1760, 1761, 1762, 1763, 1764, 1765, 1766, 1767, 1768, 1769, 1770, 1771, 1772, 1773, 1774, 1775, 1776, 1777, 1778, 1779, 1780, 1781, 1782, 1783, 1784, 1785, 1786, 1787, 1788, 1789, 1790, 1791, 1792, 1793, 1794, 1795, 1796, 1797, 1798, 1799, 1800, 1801, 1802, 1803, 1804, 1805, 1806, 1807, 1808, 1809, 1810, 1811, 1812, 1813, 1814, 1815, 1816, 1817, 1818, 1819, 1820, 1821, 1822, 1823, 1824, 1825, 1826, 1827, 1828, 1829, 1830, 1831, 1832, 1833, 1834, 1835, 1836, 1837, 1838, 1839, 1840, 1841, 1842, 1843, 1844, 1845, 1846, 1847, 1848, 1849, 1850, 1851, 1852, 1853, 1854, 1855, 1856, 1857, 1858, 1859, 1860, 1861, 1862, 1863, 1864, 1865, 1866, 1867, 1868, 1869, 1870, 1871, 1872, 1873, 1874, 1875, 1876, 1877, 1878, 1879, 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1895, 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1905, 1906, 1907, 1908, 1909, 1910, 1911, 1912, 1913, 1914, 1915, 1916, 1917, 1918, 1919, 1920, 1921, 1922, 1923, 1924, 1925, 1926, 1927, 1928, 1929, 1930, 1931, 1932, 1933, 1934, 1935, 1936, 1937, 1938, 1939, 1940, 1941, 1942, 1943, 1944, 1945, 1946, 1947, 1948, 1949, 1950, 1951, 1952, 1953, 1954, 1955, 1956, 1957, 1958, 1959, 1960, 1961, 1962, 1963, 1964, 1965, 1966, 1967, 1968, 1969, 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427



## BUSINESS FLYING



HELLER UH-120 is powered by a new Lycoming VO-540 AIA in tandem engine driving 405 maximum instrument horsepower.

## Bell, Hiller Demonstrate 1959 Versions

Latest versions of the Bell 47J Ranger and Hiller UH-120, representing 1959 models of these light helicopters for the corporate and utility markets, were demonstrated during National Business Aircraft Association annual meeting in Philadelphia (AW Sept. 29, P. 21).

Latest Bell 47J Ranger features all metal rotor blades available as optional equipment, bringing the basic price to

\$65,900 and empty weight to 3,070 lb. Gross weights with wood blades are 3,965 lb. and 3,808 lb. Useful load with metal blades is 1,216 lb. compared to 910 lb. and 1,157 lb. with wood blades.

New 47J also has an hour's greater endurance than earlier models through use of an optional fuel system providing 45 gal. replacing the standard 35 gal. This boosts Ranger's range to

metal blades to 270 mi. at 7,575 power at 5,000 ft. without reserve, compared to 175 mi. with standard tanks under the same conditions.

Lycoming VO-455 de-rated from 260 hp. to 240 hp., as fitted in a New Bell 47J-1-type aircraft, which has a take-off of 2,900 lb. compared with 600 lb. at the earlier issue.

Blade's wings of the 1959 Ranger is completely streamlined to reduce resistance. Other improvements include improved door windows and door hinges and larger arm handles over the cabin door. Company currently has approval pending on 1959 Ranger on its building.

Latest Hiller helicopter, which lists at \$59,450, is powered by the new Lycoming VO-540 AIA, over-center engine delivering 113 hp. on take-off and 105 for maximum continuous power. New UH-120 picks up more in power than incorporated in the 1958 AIA engine and adds the higher power engine to provide a maximum cruise speed at 7,575 power at 87 mph. Gross weight is 2,700 lb., providing 525 lb. for passengers or cargo. Range



BELL 47J Ranger may be optionally equipped with all metal rotor blades, for greater range.

at best cruise speed, including five minutes, versus up to 145 mi.

UH-120 incorporates a new rugged transmission system developed for the H-120 which provided for a 40% increase in power over previous models at a weight saving of 30%. Tail rotor system has simplified drive linkages and a revised gear box, relocating tail rotor to the left side and a new rotor with semi-rigid flapping hinges to eliminate tail rotor buzz.

Hiller has started an annual production run of 10 UH-120s and already sold 16, with five of these going overseas. Initial production model will roll out this month.

## PacAero Proposes D-18S Modification

A modification program on the Beech D-18S designed to increase its speed by 25 to 26 mph., eliminate gross weight by 1,000 lb. and raise critical altitude 500 ft. to 5,000 ft., in addition to other benefits, has been developed by PacAero Engineering Corp., Santa Monica, Calif.

The D-18S modernization program has been developed by PacAero in kit form so that it can be installed at the owner's facility or by an authorized local base chosen by a customer. Installation is said to take as little as five days. A PacAero representative told Aviation Week that the firm has talked out its fourth D-18S concerning the modification.

Program can complete five major basic steps:

- Kit 1, consisting of powerplant modification, utilizing new standard "Seaquest" short shock cylinders to reduce back pressure and provide higher useful power output at given available pressure and rpm. Works on design to vent through two variable shock tubes in the lower engine cowl. Improved cooling permits an increase in rpm also except intake (MEITOS) power from 490 hp. to 518 hp., with cylinder head temperatures not exceeding 184°C. Carburetor air intake is a new air scoop on the lower cowling directly below the carburetor, enabling a reduction of throat horsepower to operate the superchargers. Up to 11 in. more manifold pressure is available than with the original system, PacAero reports. New air velocity does a forced air cool to reduce drag and drops of the duct is stated to lower operating oil temperatures 28°C below standard configurations performance. Price of Kit 1, including installation, is \$3,500.

- Kit 2 consists of installing a 21,000 lbs. Stewart Warner carburetor heater on each engine airside. This costs \$7,375 installed. An electric fuel pump can be added for \$171.50 to per-

## ONLY A FEW ENGINEERS SHOULD ANSWER THIS AD

### YOU may be one of them

- ✓ Have grown rapidly but have reached an operational barrier
- ✓ Want to grow further in Weapon Systems Management
- ✓ Have an extended career with 10 or more years in airborne electronics or related application experience, including responsibility for hardware development and electronic aspects of weapon systems
- ✓ Are qualified for technical management in one of the following fields:

DEVELOPMENT OF AIRCRAFT AND MISSILE SYSTEM CONCEPTS  
ADVANCED SIGNAL TECHNIQUES AND DEVELOPMENT  
AIRCRAFT, AIRCRAFT AND GROUND EQUIPMENT DESIGN  
TEST EQUIPMENT DESIGN

Will pay competitive salaries to qualified individuals  
Selected applicants will be interviewed in St. Louis

SEND RESUME IN CONFIDENCE TO:

Raymond F. Kuehn  
Engineering Employment Supervisor  
P. O. Box 216, St. Louis 46, Mo.

**MEDONNELL** Aircraft Corporation

## SENSATIONAL NEW FLEXIBILITY

### ONE MODEL THREE MODES

✓ DIFFERENTIAL ✓ ISOLATED ✓ GROUNDED



EXTREMELY LOW DRIFT

WIDEBAND DC AMPLIFIER

Write for Bulletin #1301

AMPLIFIER ENGINEERING ASSOCIATES, INC.

MEMPHIS, TENN. • NEWARK, N.J.

TRANSMITTED POWER SUPPLIES • DIRECT ANALOG COMPARISONS • ENVIRONMENTAL ANALYSIS



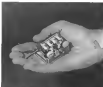
**Progress Report  
on  
Aeronutronic  
Systems, Inc.**



Dr. Montgomery H. Johnson, Director of Aeronutronic Systems, is Aeronutronic Research Staff, discusses conference related to future research flight. Other Aeronutronic Research Staff members include the study of an empty, indirect mode pressure transducer and high efficiency heat exchanger systems.



The State Wide development of an Aeronutronic test facility at the University of California, San Diego, is shown. The facility is designed to provide a high speed, high pressure, high temperature, and high density flow field and density reduction facilities.



ATI Model 8-101 Systematic Transducer pressure transducer is shown. The device is a high speed, high pressure, high temperature, and high density flow field and density reduction facilities. Size of unit: 0.1 x 0.1 x 0.2 inches. Weight: less than 1 gram. Output: 100 to 10 mV.

## How Aeronutronic is meeting the needs of advancing science and technology

The Ford Motor Company established Aeronutronic Systems, Inc. to engage in the development and manufacture of highly technical products for military and commercial purposes. In a line of expanding science, Aeronutronic is meeting the technological needs of the Nation. A few of Aeronutronic's broad interests and activities are illustrated here.



Aerial view of Newport Beach, California, where Aeronutronic Systems, Inc. is building modern, new test facilities and military and commercial products. The site of the new test facilities, which include a new test facility and a new test facility, is shown. The site is located in Newport Beach, California, and is adjacent to the Pacific Ocean.



The ATI Digital System Simulator is shown. The device is a high speed, high pressure, high temperature, and high density flow field and density reduction facilities. Size of unit: 0.1 x 0.1 x 0.2 inches. Weight: less than 1 gram. Output: 100 to 10 mV.

## AERONUTRONIC SYSTEMS, INC.

*a subsidiary of Ford Motor Company*

Development and production of Aeronutronic's laboratory facilities and products. Address: Aeronutronic Systems, Inc., Building 12, 12th Ave., Newport Beach, California.

and ground operation of the testing system. Calibrated transducer controls are 501-10 mV/psi.

- **Kit 3** comprises a set of suspended leading gear down on each aerile, fitting snugly around the gear which is rotated and used to provide an increase of force to the end of the gear. Excess are designed to permit leading gear extension at speeds up to 100 mph for testing purposes. Price of wheel well down, and fuel, is \$1,795.
- **Kit 4** includes altering the angle of incidence of the stabilizer to allow the engine to be tested properly at the higher speeds made possible by the modernization program. A P-51 engine is fitted to the horizontal stabilizer to improve testing. Total cost of Kit 4 is \$1,797.

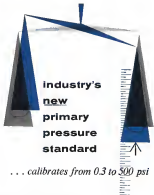
Packard also has developed a wing modification kit which provides for carrying all fuel in the wings outboard of the engine nacelles. The new wings can carry a total of 510 gal and increase weight by 10 lb. Installation shows the need for a new tank, forcing this into the mid-air, or in-flight. Packard also has D-108 wings modified at a cost of \$7,975, or can build wings for modified aircraft wings costing \$5,640. Packard will install a leading edge light kit for a design of 1975.

## Safer Visual Flying Foreseen by AMB

Greater latitude of operation by jet airplanes type traffic as well as designed for visual flight rules (VFR) flying should be possible as Aeronutronic Modernization Board's development program achieve higher degree of precision in instrument flight rules (IFR) navigation and traffic control. AMB representatives Lt Col Carl W. Fisher stated during recent 11th Airport Development and Operations Conference, New York.

Col Fisher noted that the trend toward more precise control than has not always reflected requirements of some of U. S. airports, he indicated that the major reason for this has been the need for AMB to adapt available, although reliable, equipment and techniques in the immediate phase of its long-range program. He pointed out that the airport, now it is a point where it can consider plans covering a more extensive traffic plan. And in doing so, it can consider equipment and methods greater operation can be taken of requirements of visual flight rules, including ground facilities.

As new systems come into use and provide improved management of IFR traffic, VFR traffic can be made safer and more efficient, even though the latter is equipped with a minimum of



In our product literature, CEC's 6-201 Primary Pressure Standard offers an extended range of precise pressure measurements available in no other similar equipment. Operating on a pneumatic dead-weight basis, the 6-201 offers the advantages of air rather than oil as the pressure medium, extreme accuracy of 0.01% of full range even at pressures as low as one psi, cleanliness and virtually unlimited life of the pressure range. Because this flexible gauge is absolute-type (no recent depends only on mass and length measurements for its output), it is a true primary pressure standard. It will calibrate any pressure-measuring device. Multiple combinations of piston-cylinders and weights provide six pressure ranges within the limits of 0.3 to 500 psi, each with increments of 1 lb, for both psi and absolute measurements. For additional information, call your nearest CEC sales and service office, or write for Bulletin CEC 1381-X14.



Transducer Division

**Consolidated CEC Electrodynamic**

300 North Silver Lake Blvd., Pasadena, California

REPRESENTED BY: BUREAU OF AERONAUTICS, WASHINGTON, D.C. 20330



engineers

The Boeing Airplane Company's Wichita Division offers engineers a number of long-range career opportunities in connection with advanced flight projects. These openings offer all the major benefits to enable your creative powers to the fullest.

#### AERODYNAMICISTS

Openings are for high level positions in the fields of high speed aerodynamics, VTOL, STOL research, and development. Requirements are a BS or advanced degree with four or more years of experience in aircraft as design engineer, or the ability to plan and direct development programs.

#### STRUCTURAL DYNAMICISTS

Aerodynamic and civil engineers with BS or advanced degree with four standing design functions connected with hypersonic research. Work includes completion and evaluation of calculations, finite and dynamic

load data related to design, development and research.

An outstanding career research position is also available for an aerodynamic or civil engineer with a Ph.D. and five to ten years of experience in structural dynamics and air-dynamics.

#### STRESS ANALYSTS

Openings are for mechanical, civil and aerospace engineers with a BS or advanced degree, to perform analysis of stress, vibration and structural loads in relation to production, design and research programs. Applicants should have from one to five years of design experience.

\*\*\*

In each of the above positions you will be associated with outstanding men in your field and have at your disposal some of the most up to date equipment and laboratory facilities in the industry. As an added incentive, you'll enjoy many benefits including retirement and educational programs, tuition free airfares and help in getting settled.

For further details, drop a note to R & D Manager, Dept. CFI, P.O. Box 3975, Boeing Airplane Company, Wichita 1, Kansas.

**BOEING**

airframe equipment, be stated. As yet it would be uncertain to predict the standard release equipment package required in all aircraft, he noted. In any event, AMB's program does not foresee a system that would require all aircraft to be fully equipped, but rather one that will leave the operator with the perspective of equipping his airplane to handle the type of flying in which he is most interested.

Among aerial equipment development under study by AMB mentioned in Col. Fisher, was an electronic ball sound display on the airport surface, which would present pilots with modern information regarding weather, other aircraft and other data to relieve the voice communication burden at times of congestion. Display data fed to a computer for rapid data processing.

## PRIVATE LINES

Total sales exceeding \$94 million are reported by Beech Aircraft Corp., Wichita, Kan., for fiscal 1988, ending Sept. 30 compared with \$69.9 million for same period last year. Current backlog is \$95 million. Company is going quarterly dividend of 40¢ on common stock on Nov. 6 to holders of record as Oct. 27. Dividends paid this year including extra \$1 cent cash dividend totals \$1.60 per share compared with \$1.20 last year.

Navy formal Helicopter Services will provide base and charter operations using a Bell 47G-2 and 47J based at Buffalo Airport, N.Y. Officers include: H. Leber Wheeler, Donald A. Heavner and Jack B. Pies.

Venezuela purchased 10 Beech Model 1900 for its air force and seven other. Members for the government-owned airline being school, the two countries totaling more than 57 million including spare. Deliveries begin April 1989. Venezuela is 10th government to select Model 1900 as primary trainer.

Manned helicopter test service for St. Louis area has been inaugurated by Rossmore Werner, Inc., private, either on a trip or contract basis. Radio dispatched helicopter will provide passengers with a punched card of cost is less of a receipt and includes Rossmore-Werner proposes to entirely replace these helicopters on the service.

A five-place helicopter, with gross weight of 1,600 lb. and empty weight of 1,075 lb., is being built in Culin by Tare de la Cueva Flores, a telephone of the late aviation designer. Model C-85 has a 35-hp. motor blade, is powered by a 260-hp. engine and has a top speed of approximately 125 mph.

## USAF Contracts

Following is a list of unclassified contracts for \$25,000 and over as released by Air Force Contracting Office:

**OKAWAKA CO. LTD. THE NETHERLANDS**  
Netherlands Defense Technology Products Co. Cleveland Ohio contract manufacturing overhaul, repair and test of aircraft engine. (PRC 20-9-82)(1566) \$113,150.

**Kanaka Products Corp. (Canada) P.R.C.**  
Canada. (PRC 20-9-82)(1566) \$113,150.

**Aluminum Manufacturing Co. (Canada) P.R.C.**  
Canada. (PRC 20-9-82)(1566) \$113,150.

**General Electric Co. (Canada) P.R.C.**  
Canada. (PRC 20-9-82)(1566) \$113,150.

**General Electric Co. (Canada) P.R.C.**  
Canada. (PRC 20-9-82)(1566) \$113,150.

**General Electric Co. (Canada) P.R.C.**  
Canada. (PRC 20-9-82)(1566) \$113,150.

**General Electric Co. (Canada) P.R.C.**  
Canada. (PRC 20-9-82)(1566) \$113,150.

**General Electric Co. (Canada) P.R.C.**  
Canada. (PRC 20-9-82)(1566) \$113,150.

**General Electric Co. (Canada) P.R.C.**  
Canada. (PRC 20-9-82)(1566) \$113,150.

**General Electric Co. (Canada) P.R.C.**  
Canada. (PRC 20-9-82)(1566) \$113,150.

**General Electric Co. (Canada) P.R.C.**  
Canada. (PRC 20-9-82)(1566) \$113,150.

**General Electric Co. (Canada) P.R.C.**  
Canada. (PRC 20-9-82)(1566) \$113,150.

**General Electric Co. (Canada) P.R.C.**  
Canada. (PRC 20-9-82)(1566) \$113,150.

**General Electric Co. (Canada) P.R.C.**  
Canada. (PRC 20-9-82)(1566) \$113,150.

**General Electric Co. (Canada) P.R.C.**  
Canada. (PRC 20-9-82)(1566) \$113,150.

**General Electric Co. (Canada) P.R.C.**  
Canada. (PRC 20-9-82)(1566) \$113,150.

**General Electric Co. (Canada) P.R.C.**  
Canada. (PRC 20-9-82)(1566) \$113,150.

**General Electric Co. (Canada) P.R.C.**  
Canada. (PRC 20-9-82)(1566) \$113,150.

**General Electric Co. (Canada) P.R.C.**  
Canada. (PRC 20-9-82)(1566) \$113,150.

**General Electric Co. (Canada) P.R.C.**  
Canada. (PRC 20-9-82)(1566) \$113,150.

# G.E. REDUCES PREMATURE BURNOUTS

to cut down your landing lamp replacement costs.

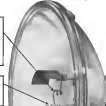
Replacement charges for landing lamps are high "Grounded" more because of burnouts is even more expensive and aggravating.

General Electric has done two things to landing lamps to keep both these expenses to a minimum.



**1 SUCCOR COILED-COIL FILAMENT—** needs no support wire to prevent sagging, eliminates premature failure caused by "sagging other" of support wire and filament.

**2 METAL STRAPS—** anchor each filament to a lead-in wire, secure constant beam aim.



Beam pattern is improved, too, because the compact filament is precisely designed and located to give a circular beam pattern of more even intensity. Yet G-E lamps cost no more—actually cost less in time of longer burning hours in service.

Ask your G-E Lamp distributor about landing lamp 4559—or write General Electric Co., Landing Lamp Dept. AW-118, Nela Park, Cleveland 12, Ohio.

Progress Is Our Most Important Product

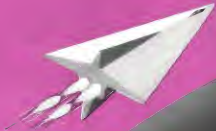
**GENERAL ELECTRIC**







# DYNA-SOAR...



**DYNA-SOAR** • • • An important step forward into the Space Age marked the award of preliminary design contracts for this advanced vehicle to the Glenn L. Martin and Boeing Aircraft Companies heading competing design teams. DynaSoar will be designed to glide around the world in a series of skips at speeds in excess of 17,000 M.P.H. Its mission is orbital reconnaissance, strategic bombing and aid in exploring the fringes of outer space.

Like other developments in Space Technology, Dyna-Soar, even though not scheduled to fly until the

1960's, will affect thousands of buying decisions tomorrow, next week, next month. AVIATION WEEK anticipated this kind of vehicle in its March 10, 1957 issue—has also described it in other technical articles—in the November 11 and December 16 issues of last year, and in the "Research for Space" edition of June 16, 1958.

The most authoritative source on Space Technology, AVIATION WEEK is also your most effective advertising medium to the entire Aviation industry including the multi-billion dollar Space Technology market.

**SPACE TECHNOLOGY** encompasses an all-star staff devoted to the exploration of the unknown. How far beyond the horizon the limits of science and the earth is travel by man and machines throughout the solar system and beyond? What will be made use of—satellite or rocket-propelled vehicles—sent beyond the earth, exploring first with the earth's own resources in order to reach these remote goals. They must also deal with hostile unknown environments.

Space Technology Magazine, reflects every discipline of the physical and the chemical and every level of engineering necessary to translate these visions into successful flight through space.

**See Today the Market of Tomorrow:  
SPACE TECHNOLOGY**

**Aviation Week**  
*Including Space Technology*

A McGraw-Hill Publication  
330 West 42nd Street, New York 36, N. Y.











# LOCKHEED

GEORGIA DIVISION

Exceptional opportunities now available in these fields:

## FLIGHT TEST INSTRUMENTATION ENGINEERS

Experience in design, calibration, development, checkout, and maintenance of flight test instrumentation for flight research and development projects. Minimum experience desirable but not essential.

## FLIGHT TEST ENGINEERS

Experience in conducting flight test in flight testing in one or more of the following areas: stability and control; performance; structural; instrumentation; vibration; altitude systems; or weapons. Minimum experience desirable but not essential. Also includes training, programming, analysis and reporting of test programs.

## FLIGHT TEST AVIONICS ENGINEERS

Experience in planning, conducting, and analysis of flight test programs in one or more of the following areas: Communication and navigation; altitude; navigation; advanced and special radio techniques.

Reply in confidence to: **Dept. AW Engineering Professional Placement**

# LOCKHEED

AIRCRAFT CORPORATION

834 W. Peachtree Street, N.W., Atlanta 9, Georgia

## Vice President—Electronic Systems

Major industrial electronic company with headquarters in Detroit offers an outstanding opportunity in successful engineering position in a national and state-wide organization. This position includes the broad management of their fully integrated electronic development department, as well as strong research laboratory. There have been several employees of 500 with planned increase of 100% during the next three years. The national organization has been demonstrated and generally accepted computer in electronic system design and development, a national trend of 5 and 10 million employees with 3 to 7 years experience in this field.

Responsible for all electronic systems and systems engineering, systems test, systems development, systems integration, systems design, production and other electronic systems.

All replies will be held in strict confidence.

Send resume to: **Mr. J. H. HARRIS, JR.,**  
CHIEF, APT. DIV. 10, 1000 N.W. 10th St.

## Your inquiry will have special value . . .

If you mention this magazine, when writing advertisers. Naturally, the publisher will appreciate it . . . but, more important, it will identify you as one of the men the advertiser wants to reach with this message . . . and help to make possible enlarged future service to you as a reader.

# ELECTRONIC ENGINEER

(Senior)

## QUALITY CONTROL

Develop test equipment, methods and procedures. Supervise maintenance of systems, components and equipment. Also test equipment.

Qualify test equipment and personnel. Develop test equipment and procedures. Supervise maintenance of systems, components and equipment. Also test equipment.

Also develop procedures for test of electronic and mechanical systems. Supervise maintenance of systems, components and equipment. Also test equipment.

Salary commensurate with ability.

In addition to other advantages, benefits offered, a comprehensive health program among the best in the industry.

Send Resume in Confidence to: **Mr. W. F. Fuld,**  
Employment Officer

**RESEARCH AVIATION**

Freehold, Long Island, N. Y.

# ENGINEERS

## Immediate Openings

Expanding research and production programs at our Boulder, Colo. and Wichita, Kansas facilities have created urgent need for qualified engineers with 3 to 7 years experience in these fields:

**AERONAUTICAL DESIGN  
AERODYNAMICS  
STRUCTURAL ENGINEERING  
COMPUTER ENGINEERING  
RESEARCH ENGINEERING  
CRYOGENIC DESIGN  
HEAT TRANSFER  
FLUID SYSTEM DESIGNS  
ELECTRONIC SYSTEMS**

Send resume to: **Mr. G. A. Jones,**  
Personnel Manager

**BEECH AIRCRAFT CORPORATION**

Wichita, Kansas

# ASI

## ENGINEERS & SCIENTISTS

Here is your opportunity to grow with a young, expanding laboratory of the Ford Motor Company. Outstanding career opportunities are open in ASI, Automotive Systems Research Center, including the Ford at Newport Beach, and the Ford at Claremont, California. You will have all the advantages of a stimulating mental environment, working with advanced equipment in a new facility, located where you can enjoy California living at its best.

**FOR ALL OUR RESEARCH OPPORTUNITIES** with ASI you may have the best for your career. ASI offers a wide range of opportunities in mechanical, electrical, and chemical engineering. In such an environment, many needed programs exist to help you develop and advance your career. ASI offers a wide range of opportunities in mechanical, electrical, and chemical engineering. In such an environment, many needed programs exist to help you develop and advance your career.

**PROGRESS ENGINEERING** with ASI you may have the best for your career. ASI offers a wide range of opportunities in mechanical, electrical, and chemical engineering. In such an environment, many needed programs exist to help you develop and advance your career.

**ADVANCED AERONAUTICAL FACILITIES** with ASI you may have the best for your career. ASI offers a wide range of opportunities in mechanical, electrical, and chemical engineering. In such an environment, many needed programs exist to help you develop and advance your career.

**FLIGHT TEST & ENGINEERING** with ASI you may have the best for your career. ASI offers a wide range of opportunities in mechanical, electrical, and chemical engineering. In such an environment, many needed programs exist to help you develop and advance your career.

**RESEARCH & DEVELOPMENT** with ASI you may have the best for your career. ASI offers a wide range of opportunities in mechanical, electrical, and chemical engineering. In such an environment, many needed programs exist to help you develop and advance your career.

**RESEARCH & DEVELOPMENT** with ASI you may have the best for your career. ASI offers a wide range of opportunities in mechanical, electrical, and chemical engineering. In such an environment, many needed programs exist to help you develop and advance your career.

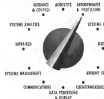
**RESEARCH & DEVELOPMENT** with ASI you may have the best for your career. ASI offers a wide range of opportunities in mechanical, electrical, and chemical engineering. In such an environment, many needed programs exist to help you develop and advance your career.

**RESEARCH & DEVELOPMENT** with ASI you may have the best for your career. ASI offers a wide range of opportunities in mechanical, electrical, and chemical engineering. In such an environment, many needed programs exist to help you develop and advance your career.

**ASI ENGINEERING SYSTEMS, INC.**  
a subsidiary of Ford Motor Company  
1000 W. 10th St. Claremont, California  
91711



## FOCAL POINT FOR SYSTEMS PLANNING



The Bendix Systems Division is located in a new two-story structure situated adjacent to the Expanding campus of the Grand University of Michigan in Ann Arbor. In new, large, built-for-you, is developed equally between laboratory and office space. The first among several new units planned for the Division, this building is designed and completely equipped for the research and development of new systems.

The Systems Division, staffed with qualified engineers and scientists is devoted to the exploration of new approaches to the development of military weapon systems. Serving as a focal point for the entire Bendix Corporation, it assures immediate attention from beginning system concept to final system production.

If you are seeking an opportunity to engage in the development of advanced weapon systems and are a qualified engineer or scientist, you are advised to write the Bendix Systems Division, Dept. ASI, Ann Arbor, Michigan. While working, you will be able to advance your education by attending day-time classes at the University of Michigan. And both you and your family will enjoy the many benefits of living in a noted university town in the heart of Michigan's "Water Wonderland."

**Bendix Systems Division**  
ANN ARBOR, MICHIGAN





# Immediate Opportunities for ENGINEERS & SCIENTISTS

*experienced in missile  
systems and subsystems*

## SYSTEMS DESIGN ANALYSTS

(Fire Control and Special Computers)

## FLIGHT MECHANICS ANALYSTS

(Trajectory and Performance)

## FLIGHT CONTROL ANALYSTS

(Maneuver Control and Aerodynamics)

## AIRBORNE RADAR SYSTEMS ENGINEERS

(Antenna, Receiver, Transmitter, RF Control)

## SYSTEMS ANALYSTS

(Statistical Air Analysis, Systems Test and Integration)

## DESIGN ENGINEERS

(Air-Vehicle Design and Rocket Engines)

## SENIOR RESEARCH ENGINEERS

(High-Temperature Materials Problems)

## PROJECT ENGINEERS

(Propellant Dosing and Rocket Engine Hardware)

## STRUCTURES ENGINEERS

## HEAT TRANSFER ENGINEERS

Solar is now expanding its creative engineering group for several challenging new projects. This is an exceptional opportunity to rapidly advance your career - while enjoying San Diego's year-round sunny climate and unmatched recreational and cultural advantages. *See Solar's advertisement in ENR magazine, 1980-1981, page 18.* Solar Aircraft Company, founded in 1967, Personal policies are advanced, including profit sharing retirement plan. Write for brochure, asking review of your qualifications, to Louis Klein, Dept. E-6004, Solar Aircraft Company, 3280 Pacific Highway, San Diego 12, California.



ADVANCEMENT: The Air Force is looking for people who are interested in the field of missile systems and who are interested in the field of missile systems and who are interested in the field of missile systems.

### POSITIONS VACANT

**Responsibility for air-launched ballistic missile systems**  
The Air Force is looking for people who are interested in the field of missile systems and who are interested in the field of missile systems and who are interested in the field of missile systems.

**Weapons/Engineers**  
The Air Force is looking for people who are interested in the field of missile systems and who are interested in the field of missile systems and who are interested in the field of missile systems.

**Weapons/Engineers**  
The Air Force is looking for people who are interested in the field of missile systems and who are interested in the field of missile systems and who are interested in the field of missile systems.

### POSITIONS WANTED

**Weapons/Engineers**  
The Air Force is looking for people who are interested in the field of missile systems and who are interested in the field of missile systems and who are interested in the field of missile systems.

**Weapons/Engineers**  
The Air Force is looking for people who are interested in the field of missile systems and who are interested in the field of missile systems and who are interested in the field of missile systems.

**Weapons/Engineers**  
The Air Force is looking for people who are interested in the field of missile systems and who are interested in the field of missile systems and who are interested in the field of missile systems.

**Weapons/Engineers**  
The Air Force is looking for people who are interested in the field of missile systems and who are interested in the field of missile systems and who are interested in the field of missile systems.

**Weapons/Engineers**  
The Air Force is looking for people who are interested in the field of missile systems and who are interested in the field of missile systems and who are interested in the field of missile systems.

**Weapons/Engineers**  
The Air Force is looking for people who are interested in the field of missile systems and who are interested in the field of missile systems and who are interested in the field of missile systems.

### MISSING OPPORTUNITIES WANTED

**Weapons/Engineers**  
The Air Force is looking for people who are interested in the field of missile systems and who are interested in the field of missile systems and who are interested in the field of missile systems.

### CONTRACT WORK WANTED

**Weapons/Engineers**  
The Air Force is looking for people who are interested in the field of missile systems and who are interested in the field of missile systems and who are interested in the field of missile systems.

### FOR SALE

**Weapons/Engineers**  
The Air Force is looking for people who are interested in the field of missile systems and who are interested in the field of missile systems and who are interested in the field of missile systems.

**Weapons/Engineers**  
The Air Force is looking for people who are interested in the field of missile systems and who are interested in the field of missile systems and who are interested in the field of missile systems.



## Man-Machine Relationships - A Changing Field for OPERATIONS RESEARCH SPECIALISTS

Changes in the very nature of System Development Corporation's work in man-machine relationships. This work involves two major projects:

- (1) creating and conducting large-scale training programs in present and planned air defense systems
  - (2) operational concepts for personnel for SAGE
- In each project, the interaction of man and computer-machine systems is of prime importance. And in each project, any change that affects air defense - a new missile, a revised concept or tactical mission, an expanded task - must be developed - requires intensive effort and cooperation by Operations Research Specialists, and its successful completion of specialists and engineers.
- In effect, specialists in many fields at SDC must work indirectly to all changes that directly or indirectly affect air defense. Their work - whether in Operations Research, Aerodynamics, or any other

mission depends to a great extent by providing man-machine relationships. In this respect, SDC is unique among companies. Operations Research Specialists, Engineers, Behavioral Scientists, and Computer Programmers whose job fields, training and intellectual capacity enable them to work in an environment of change are invited to write: Address: S. W. Frost, 2404 Columbia Avenue, Santa Monica, California, or phone collect at EDirect 3-9411 in Santa Monica.



**SYSTEM  
DEVELOPMENT  
CORPORATION**  
Santa Monica, California

An informative, non-profit organization













**Avco solves a red-hot missile problem.** Four years' research on ballistic missile reentry into the earth's atmosphere has led to major breakthroughs by Avco scientists. Nose cones have been developed and produced to withstand the shock and heat encountered during the reentry phase of an ICBM's 6000-mile flight. Now, Avco has also been chosen as prime contractor on nose cone research and development for the newest Air Force ICBM . . . the mighty, solid-propellant Minuteman.

UNUSUAL CAREER OPPORTUNITIES FOR QUALIFIED SCIENTISTS AND ENGINEERS . . . WRITE AVCO TODAY.

# Avco

AVCO MAKES THINGS BETTER FOR AMERICA / AVCO MANUFACTURING CORPORATION / 750 THIRD AVENUE, NEW YORK 17, N. Y.